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A guide to the geology of the Zion-Lake Bluff area

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ZION-LAKE BLUFF GEOLOGICAL SCIENCE FIELD TRIP

AN OVERVIEW

The Zion-Lake Bluff Geological Science Field Trip will acquaint you with some aspects of the general geology, surface topography, and mineral resources of the northeastern corner of the Chicago Metropolitan Area, home to more than 7,000,000 people. The information in this guide leaflet, in addition to your personal observations along the itinerary, will show you how geology relates to regional land-use planning and urban environmental improvement, to construction problems (structure foundations, highways, etc.), and to locating, developing, and conserving our mineral and water resources.

The geographic location and geologic setting of the Chicago region strongly influenced its growth and development from the early 1800s. Cheap water transportation, via the Great Lakes and the Illinois Waterway and the availability of mineral and water resources, led to the area's early rise to importance. A short time later, a number of railroads converged on the city to strengthen further its national and international importance and influence.

Chicago's rapidly expanding populace has not adjusted easily to its environment. Although many land-use problems have been resolved, others, such as urban sprawl and waste disposal and their interrelationships with the mineral resources of the area, have not been understood. We trust that as awareness and knowledge about the problems and some of their possible solutions become better known, more problems will be resolved so that the area will retain its desirability as a place to work and live.

This field trip area is located in the eastern part of Lake County, one of Illinois' more scenic areas. The wooded, rolling topography, studded with numerous lakes, rises westward from the Lake Michigan shorelines, and provides an ideal location for residential communities within easy commuting distance of downtown Chicago. The 1980 census lists a population of 440,372 for Lake County; more than one-fourth of these people live in the Waukegan-North Chicago area adjacent to the lake. These cities, which are located in the east-central part of the field trip area, constitute the industrial center of the county, where pharmaceutical and hospital supplies; marine equipment; asbestos building and industrial products; steel; glass; and electrical power are produced. Situated about half way between Chicago and Milwaukee, Lake County is influenced by the growth of both of these large urban centers. Indeed, it seem probable, that the eastern part of the county will become part of a megalopolis stretching from Indiana northward into Wisconsin.

Realizing that the economic and natural assets of the county will be severely stressed by uncontrolled growth, the Lake County Planning Commission is integrating data on the physical and environmental characteristics of the county as a basis for planning. The Geological Survey generated and developed a considerable amount of data, much of it compiled on maps, for the Commission during 1969 and 1970. Such information on the soils, rock materials, groundwater, and surface waters contributes to an awareness of the natural assets of the county and to an understanding of environmental limitations and problems. Development based on such an awareness presumably enhances and protects the physical environment rather than causes its deterioration.

Geologically, the Zion-Lake Bluff area in northeastern Illinois has undergone many changes throughout millions of years of geologic time. Igneous and possibly metamorphic rocks compose the ancient Precambrian basement that lies deeply buried beneath some 2,700 to 3,300 feet of younger sedimentary rock strata that were deposited in shallow seas that repeatedly covered this part of our continent. Most of these sedimentary bedrock strata are Pleozoic formations ranging in age from Cambrian through Silurian (from about 570 to nearly 375 million years old) (fig. 1). Younger Paleozoic bedrock strata, which are known from outcrops just a few miles away from the field trip area, covered this area at one time. Then, during the millions of years following the close of the Paleozoic Era and before the Pleistocene glaciers advanced into Illinois, 1 to 2 million years ago, an unknown thickness of these strata was eroded away.

Paleozoic bedrock strata in the Chicago area are not flat lying or "layer cake" in their attitude. Instead they are gently warped up across the Kankakee Arch, a broad, northwest- to southeast-trending structural arch that connects the Wisconsin and Cincinnati Arches (fig. 2). The Kankakee Arch separates two broad structural basins—the Illinois Basin to the southwest and the Michigan Basin to the northeast. The field trip area lies east of the crest of the Kankakee Arch. The bedrock strata here are depressed slightly toward the northeast about 10 to 15 feet per mile, less than 1° dip and not perceivable by the eye. Locally there are exceptions to these gentle dips. Tilting of the bedrock strata took place several time during the geologic past with the result that the bedrock strata are not parallel to each other.

System or series	Stratigraphic units and thickness(ft)	Graphic log	Rock type	Water-yielding characteristics
PLEISTOCENE	Named in figure 3 75 - 300		Unconsolidated glacial deposits, loess, and alluvium	Water yields varied; largest from thick outwash deposits in western part of county
SILURIAN	Niagaran-Alexandrian 0 - 300		Dolomite, silty at base, locally cherty	Yields moderate to large supplies where creviced and more than 50 ft. thick. May contain oil, gas, H_2S
ORDOVICIAN	Maquoketa 125 - 225		Shale, gray or brown; argillaceous dolomite	Yields small supplies from dolomite or fractured shale
	Galena-Platteville 275 - 325		Dolomite, upper part medium-grained, lower part very fine grained	Yields small to moderate supplies where creviced
	Glenwood-St. Peter 100 - 300		Sandstone, fine to coarse; thin dolomite at top; red shale and chert rubble at base	Yields moderate supplies
CAMBRIAN	Potosi 50 - 100		Dolomite, fine-grained	Yields small supplies where creviced
	Franconia 50 - 75		Dolomitic sandstone and shale	Generally not water-yielding
	Ironton-Galesville 150 - 200		Sandstone; upper part dolomitic, lower part well-sorted	Most productive bedrock aquifer in county; yields large supplies
	Eau Claire 400 - 450		Siltstone, sandstone, shale, and dolomite	Generally not water-yielding
	Mt. Simon 1500 - 2200		Sandstone, coarse-to medium-grained	Yields moderate amounts of water; water quality good at top but deteriorates with depth
PRECAMBRIAN			Granite	Not water-yielding

Figure 1. Generalized column of geologic formations in Lake County. (From Larsen, 1973.)

The bedrock surface in northeastern Illinois has been modified by the Pleistocene glaciers that repeatedly covered the area during the last 700,000 years. Some of the irregularities of the bedrock surface that were produced by pre-Pleistocene erosion were accentuated by meltwater from the early glaciers; however, some of the valleys were later filled so completely with glacial drift that in many places no surface expression of them is now visible and present-day drainage does not, for the most part, follow them. Bedrock exposures show well-developed scratches, called striations, which prove that the higher parts of the bedrock surface were scraped, rounded, and ground by the

overriding glacial ice. Its entrained rock debris acted as a giant piece of sandpaper. The ice sheet itself was several thousand feet thick and extreamly heavy when it crossed this region. Glacial deposits, being relatively weak, were easily eroded by each succeeding glacier and became incorporated into the newly forming glacial material, called till, that blankets the area. Till is a mixture of rock fragments of many types and sizes. The overall effect of glaciation in this region has been to subdue the pre-Pleistocene topography (also see attached "Pleistocene Glaciations in Illinois").

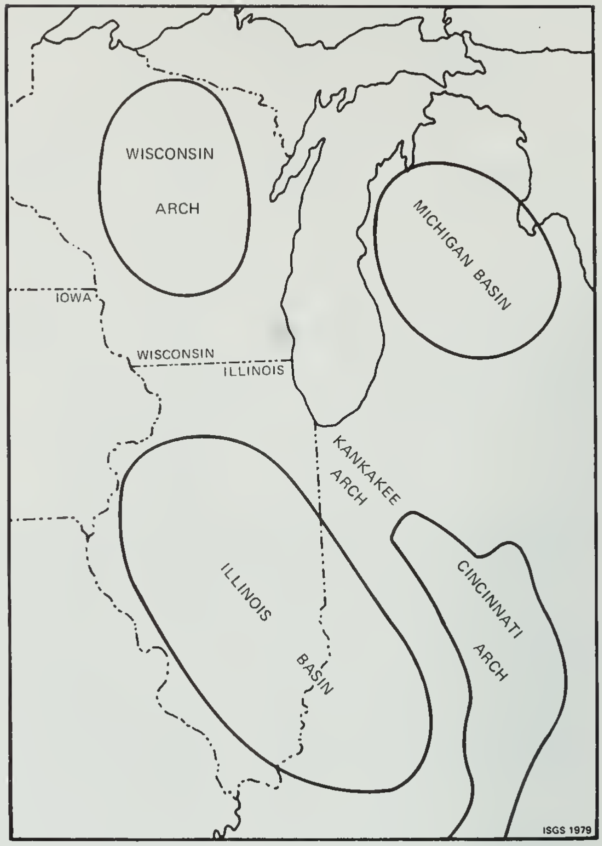


Figure 2. Location of the Kankakee Arch and adjacent structures, Wisconsin Arch, Cincinnati Arch, Illinois Basin, and Michigan Basin, in the north-central Midcontinent Region. (From Reinertsen, 1979.)

Although Pleistocene glaciers have covered nearly 85 percent of Illinois at one time or another during the past million years or so, no deposits definitely identified as pre-Illinoian have been found in northeastern Illinois. If pre-Illinoian glaciers did extend into this part of our state, erosion during subsequent glaciations has removed all evidence of them. Illinoian tills to the northwest, west, and southwest of the Chicago area indicate that Illinoian glaciers did advance southward through the Lake Michigan Basin and did cover this region. Subsequent weathering and erosion, followed by Wisconsinan glaciation, obliterated all traces of Illinoian glaciation from the field trip area.

Wisconsinan tills of the Woodfordian Substage deposited from about 12,000 to 14,000 years ago underlie this area; here the till of the Wedron Formation ranges from less than 100 feet to more than 200 feet thick (fig. 3).

As the Woodfordian glacier melted, a series of lakes formed filling low areas between the ice margin and the adjacent higher land of the end moraines surrounding what is now the Lake Michigan Basin. Some of these lakes were larger than present-day Lake Michigan, which was developed about 1,800 years ago to its present level. The glacial deposits underlying the lakes have been reworked by waves and currents; those deposits not inundated by the lakes have been subjected to the wind and running water to produce the land forms seen today.

MINERAL PRODUCTION

Mineral resources extracted from Lake County include sand and gravel, peat and groundwater. In addition, several mineral materials that originate outside the state are processed here, in order of increasing value: calcined gypsum, expanded perlite, crude iodine, and columbium. Mineral products manufactured here, in order of increasing value: clay products, glass, and fiberglass.

During 1979, the last year for which complete mineral production records are available, of the 102 counties in Illinois, 98 reported mineral production. The total value of all minerals extracted from Illinois was more than $2.2 billion. The total value of all minerals extracted, processed, and manufactured in the State was nearly $3.8 billion.

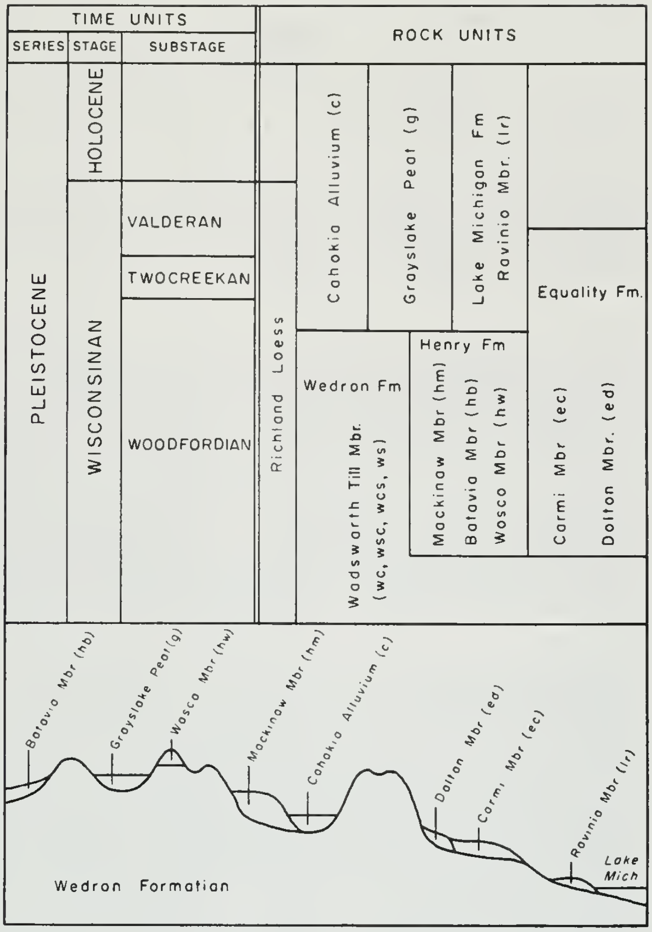


Figure 3. Geological classification and field relations of surficial materials in Lake County. (From Larsen, 1973.)

Lake County has a value of $19.1 million for 1979. Six companies, each with one operation, produced 857,908 tons of common sand and 864,875 tons of common gravel having a combined value of $2,379,059. The county ranked fifth in the production of common sand and sixth in the production of common gravel for 1979. Two companies produce peat, which is largely used as a soil conditioner. Lake County ranks second among the three peat-producing counties.

The close proximity of the sand and gravel and peat pits to the large market area in northeastern Illinois greatly reduces the shipping costs on these high bulk materials. To conserve construction materials, long-range planning is necessary so that future pit sites having thin overburden do not become covered and lost to housing developments and shopping centers.

Abundant groundwater and surfacewater suppliers are readily available in the Chicago area. It would be extremely difficult, if not impossible, to place values on them.

WATER RESOURCES

Part of the precipitation striking the Earth's surface percolates downward into the open spaces in unconsolidated earth materials and the underlying bedrock strata. The open spaces range in the size from minute pores to open joints and cracks and large crevices. Rocks are saturated below a certain depth and form the groundwater reservoir, the top of which is commonly called the "water table." Aquifers are earth materials that contain water and readily yield it to wells.

The aquifers of Lake County have supplied large quantities of water for industrial, metropolitan, and domestic needs for many years. There are two major water-yielding systems: the shallow system, consisting of the glacial drift aquifers and the shallow Silurian dolomite aquifer; and the deep sandstone system, consisting of the Ordovician Glenwood-St. Peter Sandstone and the Cambrian Ironton-Galesville Sandstone and the Mt. Simon Sandstone. The shallow aquifer system is recharged by local rainfall; the deeper aquifer system, by precipitation seeping downward through overlying rocks in the west and southwest in McHenry, Boone, De Kalb and Kane Counties.

Contrary to a popular myth, the groundwater reservoir in Illinois is not recharged with water from Lake Superior.

Although groundwater resources are available throughout Lake County, abundant quantities of good quality water in the field trip area occur mainly in the deep aquifer system. It is more imperative now than ever before that we must protect our groundwater supplies from contamination and from overuse, so that adequate supplies of good quality water will be available in the future.

Several communities along the east edge of the county draw their water supplies from Lake Michigan. Lake County municipalities withdraw about 50.4 million gallons of water per day (mg/d). A 1966 U.S. Supreme Court ruling set a limit on the amount of water that Illinois communities could withdraw from the lake—3,000 cubic feet per second (a cubic foot of water equals 7.5 gallons) for water supply and for diversion for the Chicago Sanitary and Ship Canal. Most of the diverted water (3,100 cubic feet per second) has been preempted by the City of Chicago and the Metropolitan Sanitary District. Only 100 cubic feet per second (64.6 mg/d) are left from the State's allotment for other Illinois users. Lake County has filed a report with the State noting that by the year 2000 the county will need 32.8 percent more water from Lake Michigan than it is now diverting. Interestingly enough, the current Chicago usage of lake water is estimated to draw down the lake level only about 0.5 inch annually!

Guide to the route

Assemble in the parking lot on the northwest side of Zion Park District's Leisure Center (SE 1/4 SW 1/4 NE 1/4 Sec. 21, T. 46 N., R. 12 E., 3rd P.M.; Zion 7.5-minute Quadrangle).

START

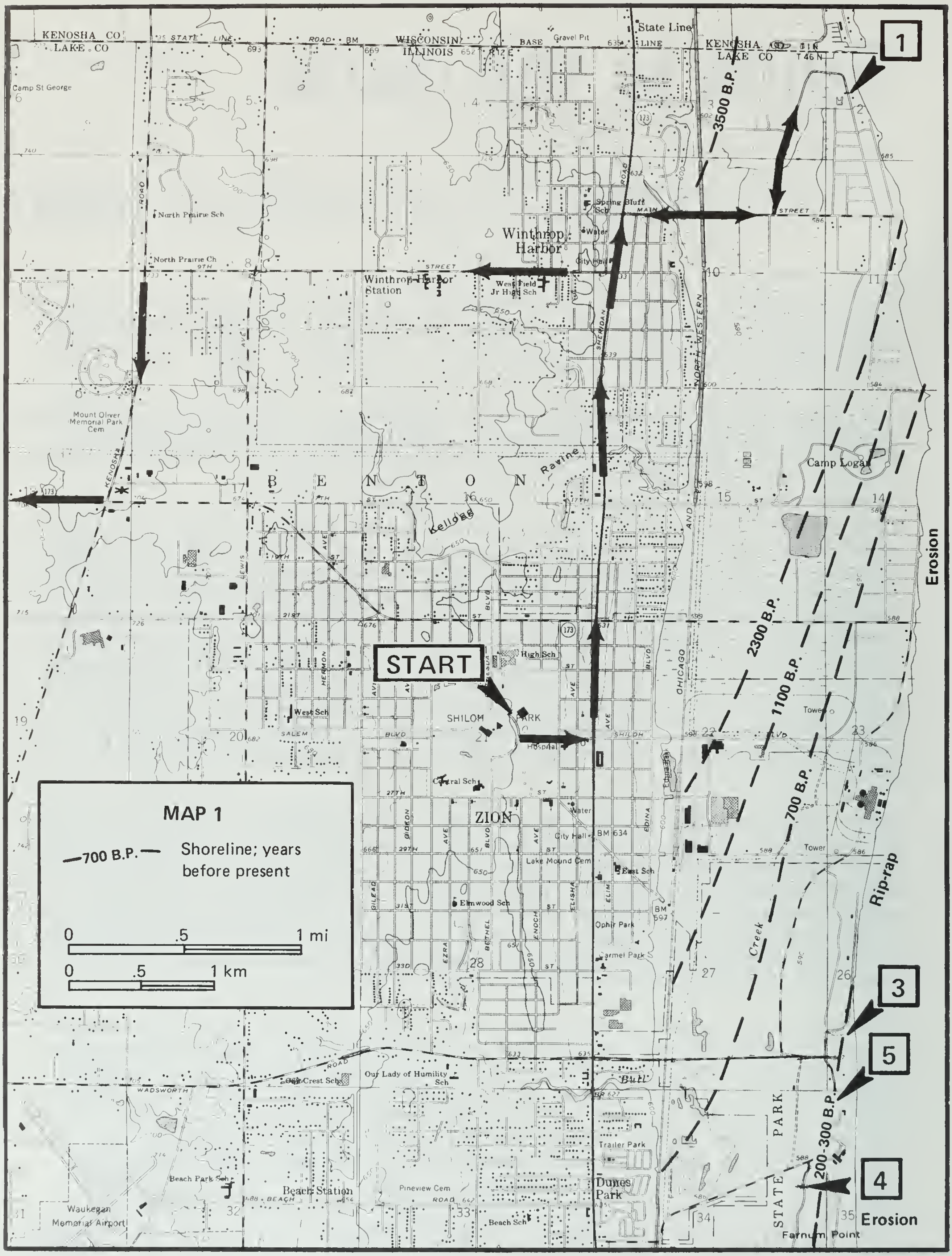
Zion was founded in 1900 as the headquarters of the Christian Catholic Church, a nondenominational Protestant Church. In 1901, Dr. J. A. Dowie, founder of this church, brought his followers to Zion in hopes of founding and perpetuating a Christian community that would live by Scriptural laws.

The entire city was planned and surveyed before any buildings were constructed, except for the then extant farm houses. Wide streets and boulevards with Biblical names focused on the Temple site at the center of the 200-acre park in which the Park District Leisure Center is now located.

Late in Woodfordian time, glacial ice of the Lake Michigan Lobe flowed southward into northeastern Illinois and deposited in Lake Border Morainic System. After the Zion City Moraine (fig. 4) was deposited the ice front melted back into the Lake Michigan Basin briefly and a short-lived ice marginal lake formed westward to the Highland Park Moraine. Although deposits of this lake have been found in the southern part of the field trip area at elevations as high as 680 feet mean sea level (msl), the lake may have extended northward into Wisconsin. After a brief readvance of the ice in the Lake Forest-Great Lakes Naval Training Center area, the glacier melted back into the Lake Michigan Basin for the final time and lake levels stabilized for a time at about 640 feet msl forming the Glenwood stage of glacial Lake Chicago (fig. 5).

The surface elevation of this parking lot is about 640 feet, therefore the shoreline of the Glenwood stage of glacial Lake Chicago may have been close by. The Glenwood shoreline, however, is not readily apparent in this area perhaps because of erosion during the past 12,000 years or so. Currents swept southward sand and fine gravel from the shore bluffs of the morains in this area and built beaches and spits in the lake. Lake Chicago drained westward for some time through the Chicago Outlet that was eroded through two low sags in the Tinley Moraine.

Lake levels fluctuated in the Great Lakes region over the last 14,000 years or so. As the ice front melted back to the north, other lower outlets were uncovered and meltwater drainage was directed through other areas. Furthermore, to the north the Earth's crust was depressed more than in this area because of the much greater thickness and weight of the overlying ice. When the ice front melted back, the crust did not immediately rebound to its earlier position and much lower outlets to the northeast were established across the southern portions of Ontario, Canada. But as the crust slowly rose to its former level, some of these outlets were tilted too high for lake drainage and were abandoned. In North America, lake levels were largely determined by the position of the ice front and the elevation of the Earth's crust.


MAP 1
700 B.P. Shoreline; years before present
0 .5 1 mi
0 .5 1 km
START
1
3
4
5
3500 B.P.
2300 B.P.
1100 B.P.
700 B.P.
200-300 B.P.
Erosion
Rip-rap
Erosion
Winthrop Harbor
Winthrop Harbor Station
ZION
SHILOH PARK
Camp Logan
STATE PARK
Farnum Point
Dunes Park
Beach Station
WISCONSIN
ILLINOIS
KENOSHA CO
LAKE CO
BENTON
Kellogg
Ravine
Creek
Bull
Waukegan Memorial Airport
Mount Oliver Memorial Park Cem

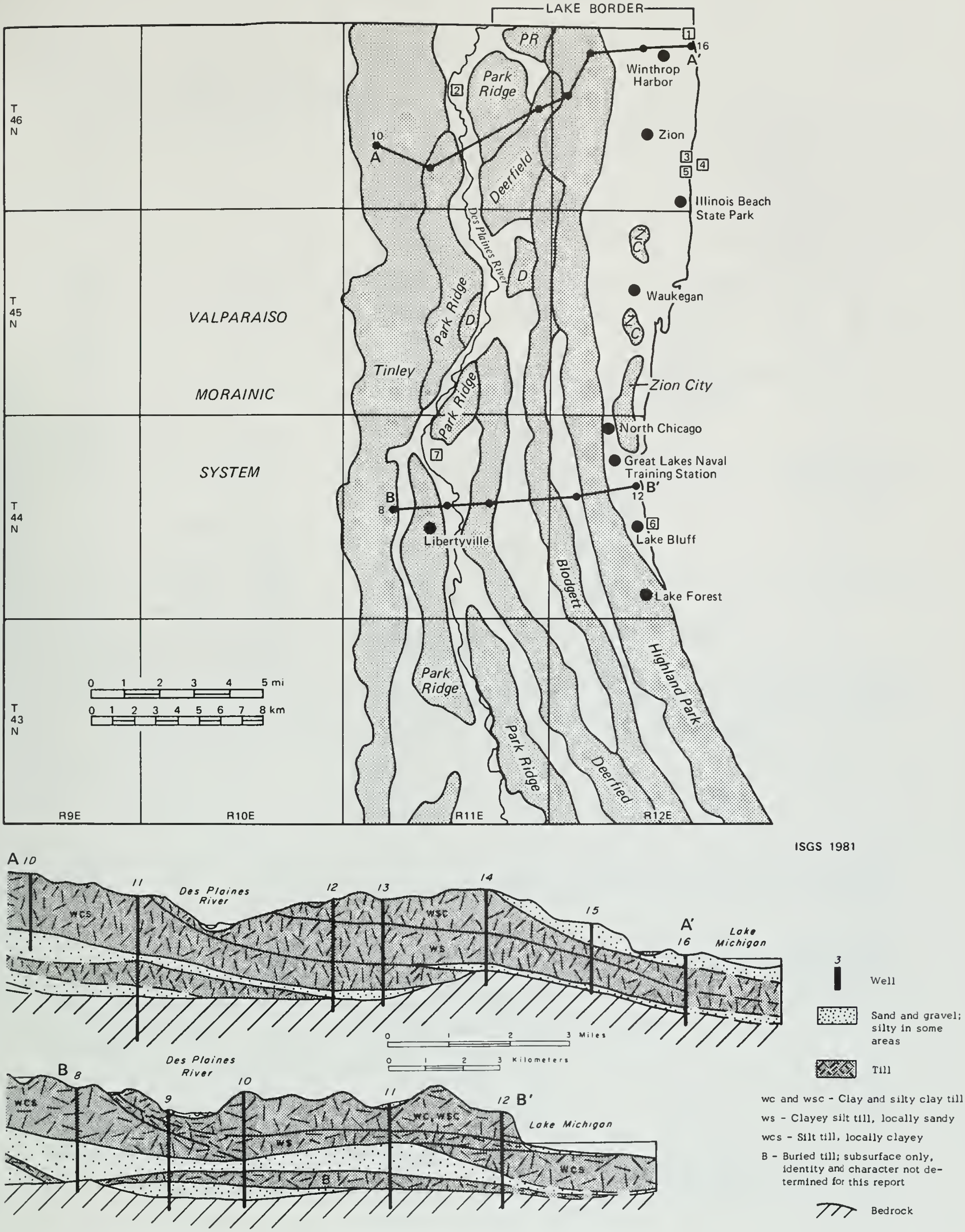


Figure 4. Moraines in Lake County. (After Willman and Frye, 1970.)

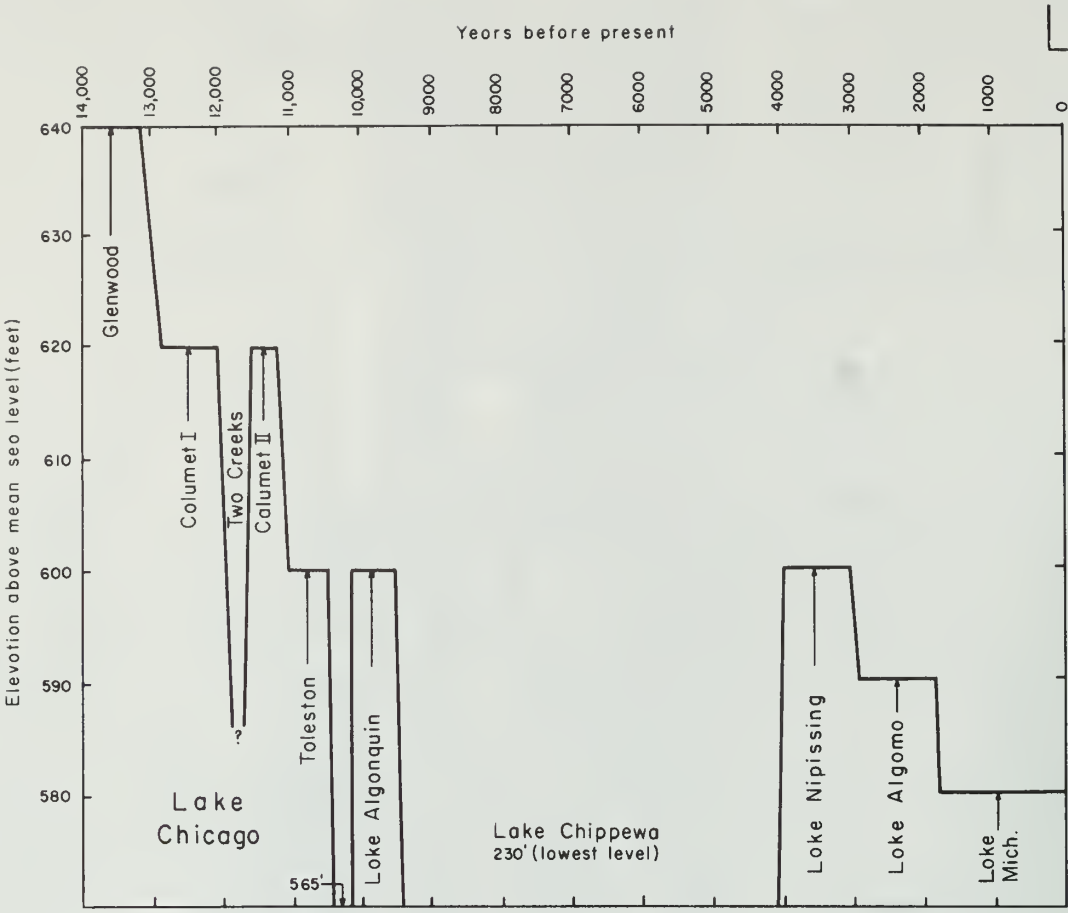


Figure 5. Elevation and ages of the glacial lakes in the southern part of the Lake Michigan Basin. (From Willman, 1971.)

The early part of the itinerary will note possible traces of the Glenwood, Calumet, and Toleston shorelines of glacial Lake Chicago.

Miles to next point	Miles from starting point	
		NOTE: Use CAUTION at designated stop signs, traffic lights, and railroad crossings and OBEY posted speed limits. YOU are on your own to get from one geology stop to another. Not all stop signs and lights are noted.
0.0	0.0	Start at northwest end of the curved driveway at the Zion Park District Leisure Center. TURN LEFT (southeast) on Dowie Memorial Drive.
0.1	0.1	TURN LEFT (east) on Shiloh Boulevard.

Miles to next point	Miles from starting point	
0.2	0.3	STOP—4-way, Emmaus Avenue. The surface elevation here and northward to 7th Street in Winthrop Harbor is at or close to 640 feet msl elevation, the Glenwood shoreline of Lake Chicago, except for Kellogg Ravine at the south edge of Winthrop Harbor. CONTINUE AHEAD STRAIGHT (east).
0.15	0.45	STOPLIGHT, Sheridan Road. TURN LEFT (north).
0.3	0.75	STOPLIGHT, 23rd Street. CONTINUE AHEAD STRAIGHT (north).
0.2	0.95	STOPLIGHT, 21st Street and State Route (SR) 173. CONTINUE AHEAD STRAIGHT (north).
0.05	1.0	Zion City limits.
0.6	1.6	Cross Kellogg Ravine. Note the "V" shape of the valley profile that leaves little or no valley flats next to the stream.
0.1	1.7	Enter Winthrop Harbor.
0.75	2.45	STOPLIGHT, 9th Street. CONTINUE AHEAD STRAIGHT (north).
0.25	2.7	TURN RIGHT (east) on 7th Street.
0.15	2.85	The third intersection east of Sheridan Road is about 620 feet msl elevation, the Calumet shoreline of Lake Chicago. Descend bluff to lake plain.
0.05	2.9	The bottom of the hill, about at the stream crossing, has an elevation of 600 feet msl, the Toleston shoreline of Lake Chicago.
0.1	3.0	CAUTION—RAILROAD CROSSING, two tracks, Chicago and Northwestern (C & NW) Railroad. CONTINUE AHEAD STRAIGHT (east).
0.3	3.3	TURN LEFT (north) at entrance to Spring Bluff Forest Preserve, just short of the cul-de-sac. The blocked portion of 7th Street goes to the Lake Michigan shore to an abandoned residential area that is now administered by the Illinois Department of Conservation.
0.65	3.95	TURN RIGHT (east) just short of the boat ramp parking area.
0.15	4.1	STOP—1-way. TURN RIGHT (south).
0.1	4.2	STOP 1. Park in lot and proceed to area north of picnic shelter for discussions of land surveys and beach erosion.

STOP

1

SW 1/4 NW 1/4 SW 1/4 Sec. 2, T. 46 N., R. 12 E., 3rd P.M. (principal meridian), Lake County; Zion 7.5-minute Quadrangle).

This stop is approximately 384 miles north and 76 miles east of the southernmost tip of Illinois, which is on Angelo Towhead, an island in the Mississippi River.

This locality affords the opportunity of examining the system of land surveys in Illinois. An examination of the 15- and 7.5-minute quadrangles of Illinois shows that section lines do not show an even grid pattern over the whole area. In some areas section lines have been omitted; in other areas there are some lines that are quite irregular and represent old French land grants, established when early French settlers were mainly concerned about the amount of riverfront footage that they could buy. Additionally, the 3rd Principal Meridian does not appear on these maps, even though a decision in 1805 regarding land surveys designated the mouth of the Ohio as the beginning point for this meridian.

In 1804, initial surveying from the 2nd P.M. (fig. 6) continued westward from Vincennes, Indiana; this survey became the basis for surveying about 10 percent of what is now eastern Illinois. Because the western boundary of this tract had not been established with certainty, it was decided in 1805 to designate the 3rd P.M. as beginning at the mouth of the Ohio River and extending northward, to facilitate surveying new land cessions. By late 1805 a base line had been run due east to the Wabash River and due west to the Mississippi River from the 3rd P.M. During March 1806, surveying commenced northward on both sides of the 3rd P.M. Sometime after the selection of an initial point from which to establish a base line, and from which the surveys were to be laid out, the base line apparently was arbitrarily moved northward 36 miles, where it roughly coincides with the base line of the 2nd P.M.

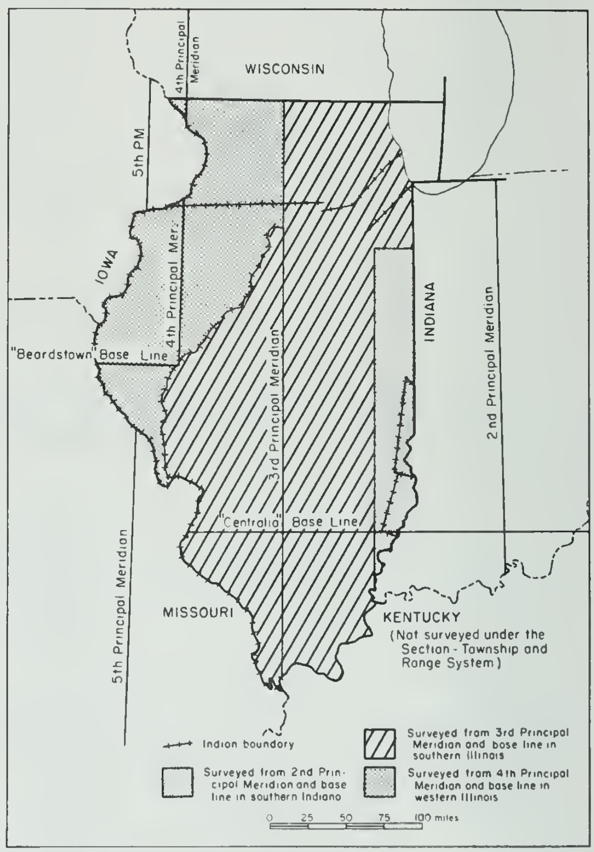


Figure 6. Principal meridians and base lines of Illinois and surrounding states. (From Cote, 1978.)

The township and range system permits the accurate identification of most parcels of land in Illinois to facilitate the sale and transfer of public and private lands. In the

early 1800s, each normal township was divided (to the best of the surveyor's ability) into 36 sections, each of which was 1 mile square and contained 640 acres (see route map).

Township and range lines in figure 7 do not form a perfect rectangular grid over the state because of the use of different base lines and principal meridians and because minor offsets were necessary to compensate for the Earth's curvature. The surveying corrections producing the minor offsets were usually made at regualr intervals of about 30 miles. Figure 7 shows what happened when the survey from the 2nd P.M. met the survey from the 3rd P.M. From Iroquois County south to White County, only narrow partial townships could be made where the two surveys met. These partial townships are all located in R. 11 E. and, in most places, are less than one section wide.

Figure 7. Index map. (From Cote, 1978.)

The Illinois-Wisconsin boundary is situated along the south edge of the channel that was dug for the marina. An examination of Map 1 shows that township and range numbers change at the state line. At this stop, we are in Sec. 2, T. 46 N., R. 12 E., 3rd P.M. Just across the state line in Wisconsin the location is Sec. 32, T. 1 N., R. 22 E., 4th P.M. You must read the range numbers from the bottom edge of quadrangle maps along the Illinois-Wisconsin border for locations in Illinois and along the top edge for locations in Wisconsin.

The Wisconsin land survey is based on the 4th P.M., the initial point of which is in the Illinois River in west-central Illinois. Wisconsin, however, does not use our "Beardstown" Base Line; instead, they use the south boundary of Wisconsin as their base line. (See Fig. 6.)

We are not standing at the northeastern corner of Illinois at this stop. Figure 6 shows that the northern boundary of Illinois extends eastward for approximately 40 miles to the center line of the lake.

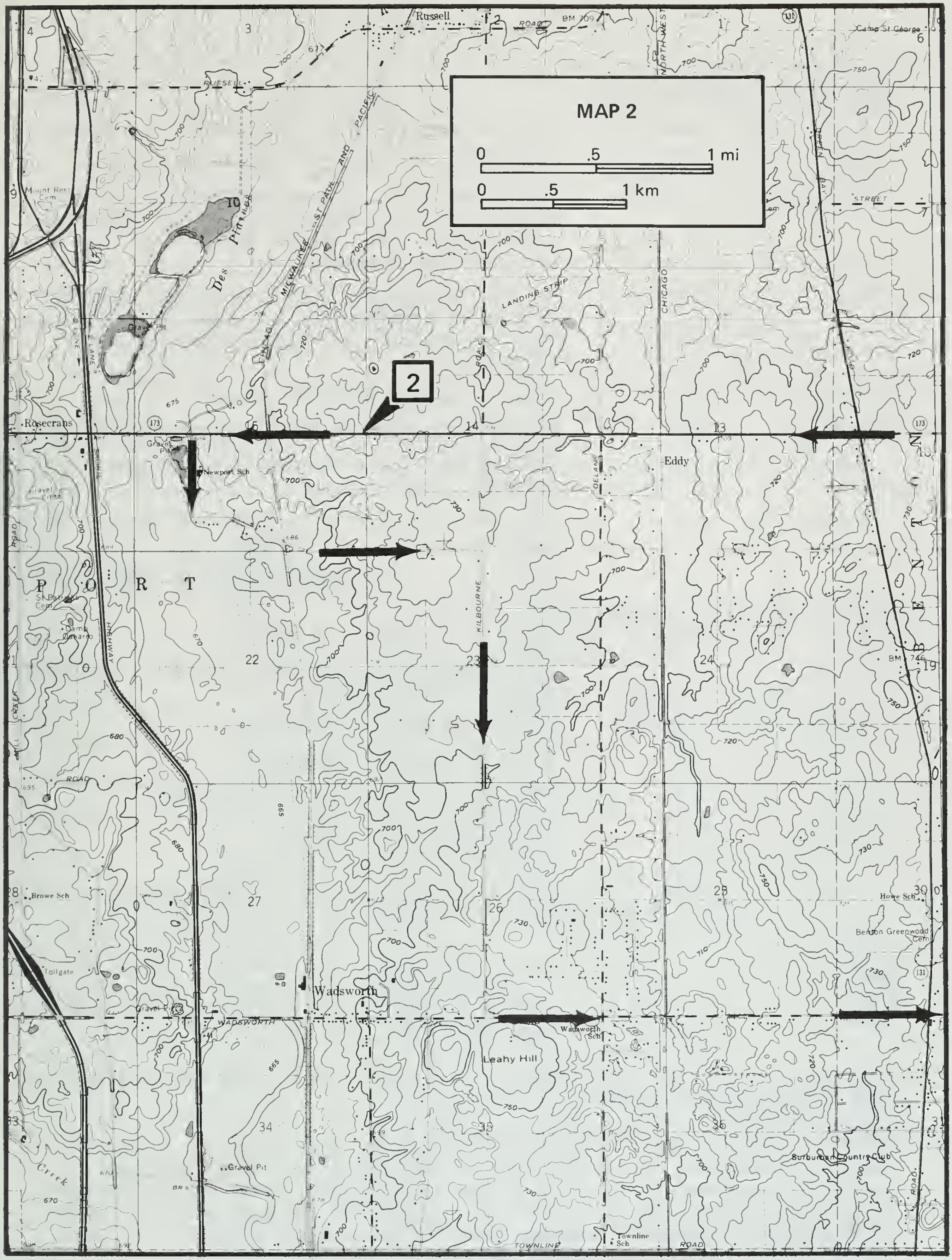
Stop 1 is part of a beach-ridge complex that extends from just east of Waukegan northward for about 14 miles to the Kenosha, Wisconsin, area. That portion of the complex that is above water level is about 1.1 miles wide at Illinois Beach State Park, about 5 miles to the south, and narrows northward to just southeast of Kenosha, where it essentially disappears. That part of the complex consists of several distinct environments, including beach ridges, dune ridges, marshes (bogs), and modern beaches. All parts of the complex are transitory and subject to change by forces generated by the lake system. That portion of the complex that is below water level forms an apron of sand that slopes gently eastward from the shore for 1.0 to 1.5 miles.

A beach ridge, such as is found in this area, is a sediment body that is attached to shore and partially rises above water; it is formed by an overabundance of sediments transported into the area by long-shore currents operating in the lake. A beach ridge, therefore, is a highly mobile, impermanent feature. The same high-energy processes that constructed it can partially or totally destroy it. Note the small ridges trending southwesterly in the vicinity of the shelterhouse.

Briefly let us examine some lake shore features and problems. Later stops during the day will focus attention on the lake shore beaches and bluffs. Rainfall patterns cause fluctuations of several feet in the levels of the present Great Lakes; these fluctuations cause many problems on the lakes. When the water is high, beaches and bluffs are eroded and many properties sustain major damage. When lake levels are low, fishing and boating piers may be left in water too shallow to permit use of the structures.

The 1960 edition of the Zion 7.5-minute Quadrangle map shows a street about 350 feet east of the street leading to the picnic shelter parking lot. At that time, this street was at least 100 feet west of the shoreline. The 1972 photorevised edition of the Zion map shows the shoreline to be about 200 feet east of the parking lot street. Presently the shoreline is less than 200 feet away from the street. The Lake County Forest Preserve is planning to move the shelterhouse from its present location to the concrete pad west of the street because they feel that the present location will soon be inundated.

Miles to next point	Miles from starting point	
0.0	4.2	Leave stop 1. Retrace itinerary to Winthrop Harbor.
0.1	4.3	TURN LEFT (west).
0.15	4.45	TURN LEFT (south).
0.65	5.1	STOP—1-way. TURN RIGHT (west) on 7th Street.
0.3	5.4	CAUTION—C & NW Railroad crossing. CONTINUE AHEAD (west).
0.1	5.5	This is the 600 foot elevation msl of the Toleston stage shoreline of Lake Chicago.
0.1	5.6	The cross street is close to the 620 foot elevation msl Calumet stage shoreline of Lake Chicago.


MAP 2
0 .5 1 mi
0 .5 1 km
2
Russell
Camp St George
Mount Rest Cem
Des Plaines
CHICAGO MILWAUKEE ST PAUL AND PACIFIC
LANDING STRIP
Rosecrans
Newport Sch
Eddy
KILBOURNE
CHICAGO
NORTH WESTERN
P O R T
BENTON
Browe Sch
Tollgate
Wadsworth
Wadsworth Sch
Leahy Hill
Howe Sch
Benton Greenwood Cem
Suburban Country Club
Townline Sch
TOWNLINE ROAD
WADSWORTH
Gravel Pit
Creek

Miles to next point	Miles from starting point	
0.15	5.75	STOP—2-way, Sheridan Road. TURN LEFT (south).
0.25	6.0	STOPLIGHT, 9th Street. TURN RIGHT (west).
0.05	6.05	The first street intersection west of Sheridan Road is at an elevation of about 640 feet msl, approximately the highest shoreline of Lake Chicago, the Glenwood.
1.0	7.05	To the right on the east side of the abandoned Chicago North Shore and Milwaukee (NS) Railroad, is a low exposure of Highland Park ground moraine.
0.05	7.1	Cross abandoned NS right-of-way.
0.25	7.35	Ascend back slope of the Highland Park Moraine.
0.2	7.55	STOP—2-way, Lewis Avenue. CONTINUE AHEAD STRAIGHT (west).
0.45	8.0	STOP—4-way. TURN LEFT (south) on Kenosha Road. North Prairie Church to right.
1.0	9.0	STOP—4-way. TURN RIGHT (west) on State Route (SR) 173.
0.65	9.65	Crest of Highland Park Moraine.
0.1	9.75	STOP—4-way, Green Bay Road (SR-131). CONTINUE AHEAD STRAIGHT (west).
0.05	9.8	Cross onto Deerfield Moraine.
0.4	10.2	Crest of Deerfield Moraine.
0.4	10.6	CAUTION: C & NW Railroad crossing.
0.15	10.75	Ascend Park Ridge Moraine.
1.15	11.9	Crest of Park Ridge Moraine.
0.05	11.95	STOP 2. View to west of Des Plaines River Valley and the Tinley Moraine.

STOP

2

View from near the SW corner SE 1/4 SE 1/4 SE 1/4 NE 1/4 Sec. 15, T. 46 N., R. 11 E., 3rd P.M., Lake County; Wadsworth 7.5-minute Quadrangle.

CAUTION—Park well off the highway on the north side. Leave car on passenger side because of fast traffic.

Westward from Zion the itinerary has crossed the gently rolling topography developed on several of the moraines of the Lake Border Morainic System. Stop 2 is just west of the crest of the Park Ridge Moraine, the westernmost of the Lake Border moraines, which are composed of the Wadsworth Till Member of the Wedron Formation. The Wadsworth Till is a gray, clayey to silty till that has a relatively low content of pebbles, cobbles, and boulders.

The Tinley Moraine, the high ground farther west, is also composed of Wadsworth Till. The landscape west of the Des Plaines River has a much more undulating surface than the area east of the river. Local areas on the east side exhibit some knob-and-kettle topography, but not to the extent seen to the west. The large tracts of knob-and-kettle topography, the many kames, and the numerous lakes scattered across the area to the west may have developed as a result of the late Woodfordian glacier having overridden an eroded outwash plain left by an earlier glacier that covered the region.

The Des Plaines River, nearly a mile to the west of this stop, has an unusual course. It enters Illinois two miles north of here and nearly six miles west of Lake Michigan. It flows southward for nearly 22 miles roughly paralleling the Lake Michigan shoreline before emptying into the old Lake Chicago outlet channel and the Illinois River. In some places the channel lies between the Tinley and Lake Border Moraines, but in other places, especially in the northern part of Illinois, it cuts across low sags in the Park Ridge and Deerfield Moraines to flow a couple of miles east of the Tinley Moraine. Farther south, its course is across the Tinley ground moraine in front (west) of the Lake Border Morainic System. Initially its course was determined by meltwater flowing southward from one low sag to another in the area between the moraines here.

Miles to next point	Miles from starting point	
0.0	11.95	Leave Stop 2. CAUTION upon reentering the highway. CONTINUE AHEAD STRAIGHT (west) and descend the Park Ridge Moraine.
0.35	12.3	CAUTION: Chicago, Milwaukee, St. Paul, and Pacific (CMStP & P) Railroad crossing; two tracks.
0.25	12.55	Prepare to turn left.
0.1	12.65	TURN LEFT (south).
0.35	13.0	TURN LEFT (east); note view to right of Park Ridge Moraine.
0.4	13.4	CAUTION: CMStP & P Railroad crossing.
0.1	13.5	Ascend Park Ridge Moraine front.
0.75	14.25	STOP—2-way. TURN RIGHT (south) on Kilbourne Road.
0.4	14.65	Cross an area for 0.3 mile that is underlain by Grayslake Peat deposits.
0.65	15.3	Cross onto Deerfield Moraine.
0.6	15.9	Cross another 0.1 mile area underlain by Grayslake Peat deposits. This vicinity has one of the better examples of knob-and-kettle topography on this field trip.
0.2	16.1	Note bog to right.
0.15	16.25	STOP—1-way. Note Wadsworth till exposure to left in low roadcut. TURN LEFT (east) on Wadsworth Road.

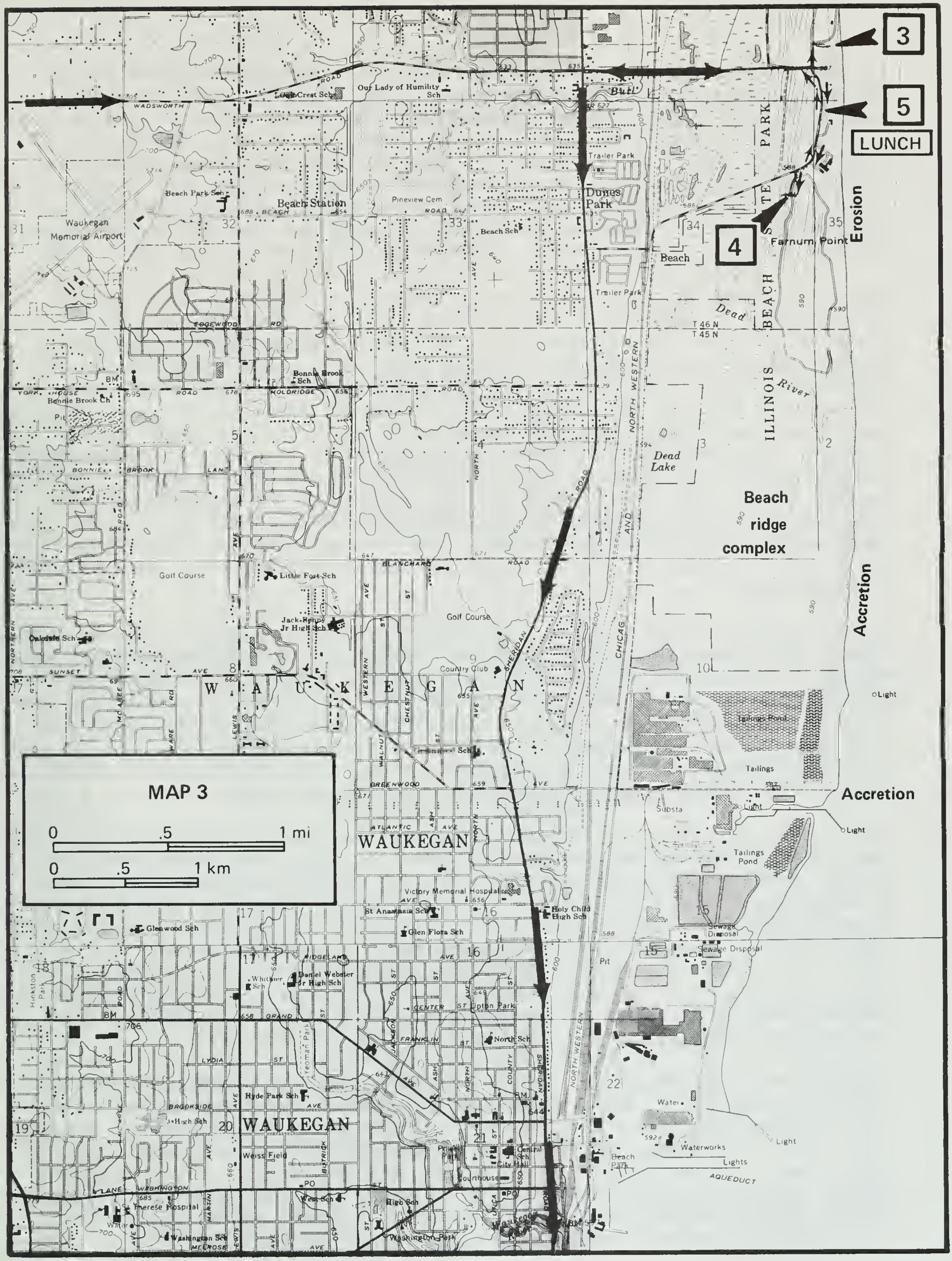
Miles to next point	Miles from starting point	
0.5	16.75	CAUTION: Delany Road. CONTINUE AHEAD STRAIGHT (east).
0.25	17.0	CAUTION: C & NW Railroad crossing.
0.4	17.4	Cross onto Blodgett Moraine.
0.55	17.95	Ascent Highland Park Moraine.
0.2	18.15	STOP—4-way, Green Bay Road (SR-131). CONTINUE AHEAD STRAIGHT (east). See Map 3.
0.2	18.35	Waukegan Memorial Airport to right.
0.9	19.25	STOP—4-way, Lewis Avenue. CONTINUE AHEAD STRAIGHT (east).
1.5	20.75	STOPLIGHT: Sheridan Road. CONTINUE AHEAD STRAIGHT (east) toward Illinois Beach State Park.
0.3	21.05	CAUTION: C & NW Railroad crossing. Note well-developed marshland beyond railroad crossing.
0.45	21.5	CAUTION: Illinois Beach State Park Campground entrance. CONTINUE AHEAD STRAIGHT (east).
0.1	21.6	Note the stabilized sand ridges on both sides of the road.
0.15	21.75	STOP—4-way. CONTINUE AHEAD STRAIGHT (east) toward beach and camp store.
0.05	21.8	TURN LEFT (north) into parking area.
0.1	21.9	STOP 3. View of beach area and erosion problems.

STOP
3

E 1/2 NW 1/4 SW 1/4 SW 1/4 and E 1/2 SW 1/4 NW 1/4 SW 1/4 Sec. 26, T. 46 N., R. 12 E., 3rd P.M., Lake County; Zion 7.5-minute Quadrangle.

NOTE: Parking is available on either side of the driveway near the northeast corner of the parking area.

This locality in Illinois Beach State Park shows the same features of the beach ridge complex first observed at Stop 1. Here the complex consists of beach ridges, dune ridges, marshlands, and the modern beach. The beach ridges are frequently covered by trees and can be recognized easily from the air as north-south lineations that are gently curved to the southwest in the southern part of Illinois Beach State Park (Nature Preserve). Topographically, the beach ridges generally rise only a few feet above the surrounding marshland areas. Each beach ridge marks a former major shoreline position during the formation of this complex. The fine-grained sand on these shorelines was often blown into dunes of sand that cover most of the beach ridges. The dune ridges thus formed are generally 10 to 15 feet above the surrounding area. Most dune ridges were eventually stabilized by grasses and shrubs.


MAP 3
0 .5 1 mi
0 .5 1 km
3
5
LUNCH
4
Erosion
Farnum Point
ILLINOIS BEACH STATE PARK
Dead River
Dead Lake
Beach ridge complex
Accretion
Accretion
Tailings Pond
Tailings
WAUKEGAN
Dunes Park
Beach Station
Waukegan Memorial Airport
Beach Park Sch
Pineview Cem
Trailer Park
Golf Course
Country Club
Victory Memorial Hospital
Sewage Disposal
Waterworks
Beach Park
AQUEDUCT
Washington Park
St Therese Hospital
Weiss Field

The beach ridge complex began forming about 3,500 years ago when the lake was about 20 feet higher than its present level. At this higher level, the ancestral Lake Michigan (geologically termed Lake Nipissing stage) eroded glacial material from the bluffs along the lake shore in this area and farther north. The sand and gravel in the glacial material was gradually transported southward by waves and longshore currents to form some of the earliest ridges in the northwest corner of the present complex. Most of the beach ridge complex formed in the last 2,000 years when the lake level dropprd and more or less stabilized at its present elevation of 580 feet msl.

During the formation of the beach ridge complex, periods of erosion undoubtedly occurred as indicated by truncated beach ridges within the complex. Since 1872, erosion of the shorelands has occurred along the northern two-thirds of the complex while the southern third still shows some gradual addition to the shore (accretion). Part of this accretion is sand eroded from the northern parts of the complex, both in Illinois and Wisconsin, and transported southward. The other portion of sand comes from areas north of the complex. The amount of sand being transported along the shore in recent years has decreased. This decrease can be attributed to the harbors at Milwaukee, Racine, Kenosha, and even Trident, which trap much of the sediment from the littoral (long shore currents in shallow water) drift. Armoring of previously eroding shorelines also prevents sand from entering the littoral drift. These facts have generally accelerated the shoreline retreat for the complex in recent years.

At the Illinois-Wisconsin state line, about 1,100 feet of erosion has occurred since 1872 or about 10 feet of shoreline retreat per year on the average. Here in the vicinity of the main beach, about 300 feet of erosion has occurred since 1872 (3 feet/year). At Dead River, about a half-mile south of the Holiday Inn beach resort, erosion and accretion have offset each other (0 feet/year) and near Waukegan about 600 feet of shoreland has accreted since 1872. In the next 50 years, however, the accretion rate will slow in the southern third of the complex with erosion gradually taking over by the year 2030.

Here at the main beach, of the 300 feet of retreat that has occurred since 1872, about 250 feet has occurred in the last 8 to 10 years. This high erosion rate for the last decade is due to several factors. First, this has been a period of higher than normal lake levels, which ultimately translates to a period of increased erosion. The level of the lake normally fluctuates several feet in a 20 to 30 year irregular cycle. Therefore, when the lake level drops 2 or 3 feet, the beach will build out and regain a part of the beach lost in the previous high-lake-level portion of the cycle. In this area, the beach generally does not regain the entire portion lost to erosion, which results in a net erosional effect over the total period of a lake level cycle.

Second, erosion increased in the early 1970s because of a temporary breakwater emplaced for a year or two by Commonwealth Edison during the construction of their nuclear power plant in Zion, just north of this part of Illinois Beach State Park. This breakwater partially interrupted the littoral drift for more than a year, increasing the rate of erosion for the reach of shore from the nuclear power plant to approximately the Holiday Inn beach resort. Commonwealth Edison officials responded by providing sand and gravel to replenish this stretch of shore. This material temporarily reduced shore erosion for

about a year. Additional sand has been replenished, but this also is being slowly eroded away. To continually protect this part of the shore, sand will need to be replenished periodically or a more permanent type of protection installed such as stone revetments or steel bulkheads, which now in part protect the Holiday Inn beach resort. And this is only a small segment of the shoreline along the beach ridge complex! What is to be done with the more severely eroding portion of the complex just south of the Illinois-Wisconsin state line, which has been acquired as an extension of Illinois Beach State Park? Should it be protected? If so, at what cost? Or should the natural geologic processes be permitted to take their course?

Miles to next point	Miles from starting point	
0.0	21.9	Leave Stop 3. TURN LEFT (west) toward parking lot drive.
0.05	21.95	STOP—2-way. TURN LEFT (south).
0.1	22.05	STOP—4-way. CONTINUE AHEAD STRAIGHT (south) past the Park Headquarters and Holiday Inn.
0.35	22.4	Entrance to Illinois Beach Resort, Holiday Inn to left. CONTINUE AHEAD AND BEAR RIGHT (southwest).
0.15	22.55	TURN LEFT (southerly) at Nature Area sign and then BEAR RIGHT (south).
0.1	22.65	BEAR RIGHT into the parking area for the Interpretive Center. STOP 4. Discussion of features of beach ridge complex that are removed from the beach.

STOP 4

S 1/2 SE 1/4 NE 1/4 Sec. 23, T. 46 N., R. 12 E., 3rd P.M., Lake County; Zion 7.5-minute Quadrangle.

Route map 1 shows the south-southwest trend of beach ridges in the field trip area. Radio-carbon dating methods have been used to ascertain the ages of these ridges. The oldest ridge was formed 3,500 years before the present (B.P.) and is located west of Stop 1. The youngest ridge is 200 to 300 years B.P. and lies east of this parking area. Thus, there is a progression from oldest to youngest from northwest to southeast across the area.

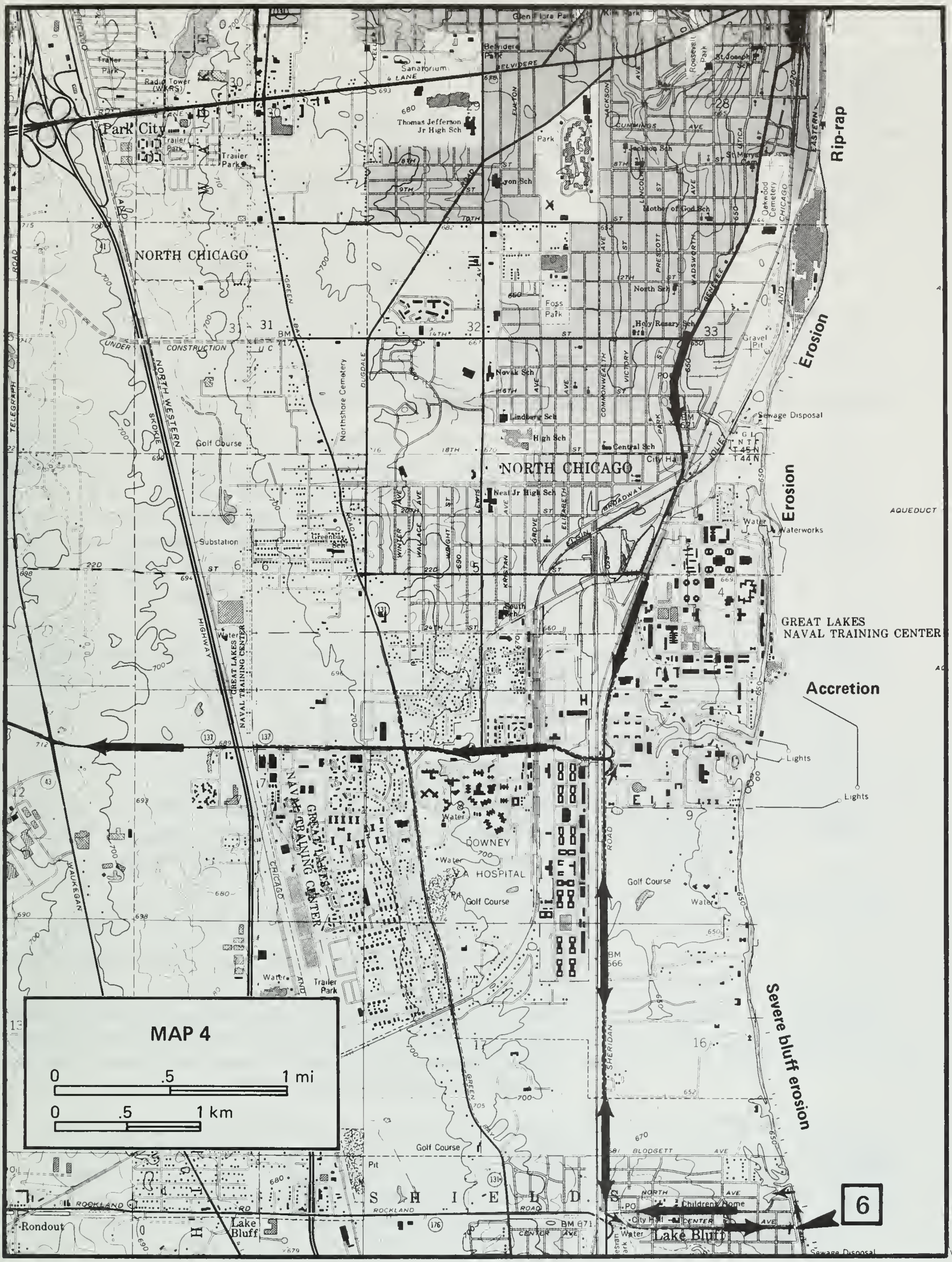
The soils that are developing on the ridges here are very young. The ridge tops are well drained and highly oxidized, but a few yards away the slopes are poorly drained. Plants growing on the ridges mirror the soil type and drainage character present. Beach grasses, cacti, and goldenrod are found on the ridge tops, while dogwood, Indian grass, and blazing star are found along the slopes. The poorest drained areas are the swales between the ridges where sedges and bullrushes are plentiful.

As noted at Stops 1 and 3, the beach ridge complex is widest in this vicinity, about 1.1 miles wide from the shoreline westward to the bluff. From the size of the tree cover here, it is hard to imagine that this area might be in

jeopardy from Lake Michigan. However, a look at Route Map 3 and the Zion 7.5-minute Quadrangle shows that more than 200 feet of beach less than 1/4 mile east of here was eroded away during 1960 to 1972. High lake levels, therefore, do pose a serious threat to the beach ridge complex.

The Interpretive Center has a number of displays featuring plants and animals found in the beach ridge complex. In addition, there is an exhibit about glaciation and the history of glacial Lake Chicago. The spiral staircase on the outside leads to an observation platform on the roof on the Center. This deck provides an excellent view of the marshland to the west of these youngest beach ridges.

Miles to next point	Miles from starting point	
0.0	22.65	Leave Stop 4. CONTINUE AHEAD STRAIGHT (south) and then loop back through the east part of the parking area to retrace itinerary to Zion.
0.2	22.85	STOP—1-way. TURN RIGHT (northeast).
0.3	23.15	STOP 5. Park in available area on either side of road. LUNCH.
STOP 5		W 1/2 NW 1/4 NW 1/4 NW 1/4 Sec. 35, T. 46 N., R. 12 E., 3rd P.M., Lake County; Zion 7.5-minute Quadrangle.
0.0	23.15	Leave Stop 5. CONTINUE AHEAD STRAIGHT (north).
0.2	23.35	STOP—4-way. TURN LEFT (west).
0.7	24.05	CAUTION: C & NW Railroad crossing.
0.2	24.25	Prepare to turn left.
0.1	24.35	STOPLIGHT: TURN LEFT (south) on Sheridan Road.
1.35	25.7	STOPLIGHT: Yorkhouse Road. CONTINUE AHEAD STRAIGHT (south).
0.8	26.5	CAUTION: Waukegan City Limits.
1.05	27.55	STOPLIGHT: Greenwood Avenue. CONTINUE AHEAD STRAIGHT (south).
1.45	29.0	STOPLIGHT: Grand Avenue (SR-132). CAUTION: this is the east side of the Waukegan Business District. CONTINUE AHEAD STRAIGHT (south). NOTE: Hill to right (west) is the backslope of the Zion City Moraine. To left (east) are glimpses of Waukegan Harbor.
0.3	29.3	STOPLIGHT: Washington Street. CONTINUE AHEAD STRAIGHT (south).
0.3	29.6	STOPLIGHT: Belvidere Street (SR-120). CONTINUE AHEAD STRAIGHT (south and then southwest)
		See Map 4.


MAP 4
0
.5
1 mi
0
.5
1 km
Rip-rap
Erosion
Erosion
Accretion
Lights
Lights
Severe bluff erosion
6
NORTH CHICAGO
NORTH CHICAGO
Park City
GREAT LAKES
NAVAL TRAINING CENTER
DOWNEY
VA HOSPITAL
Golf Course
Golf Course
Golf Course
Sewage Disposal
Waterworks
Foss Park
Glen Flora Park
Thomas Jefferson Jr High Sch
Northshore Cemetery
Oakwood Cemetery
SHERIDAN ROAD
BLODGETT AVE
Lake Bluff
Lake Bluff
Rondout
SHIELDS
AQUEDUCT

Miles to next point	Miles from starting point	
0.3	29.9	STOP—1-way. BEAR LEFT (south-southwest) on Genessee Street.
0.7	30.6	CAUTION: North Chicago City Limits, 10th Street.
0.05	30.65	Cross onto backslope of Zion City Moraine, which has very little relief here.
0.5	31.15	STOPLIGHT: 14th Street. CONTINUE AHEAD STRAIGHT (southerly). Abbott Pharmaceutical Laboratories and manufacturing facilities to left (east).
0.65	31.8	Elgin, Joliet and Eastern (EJ & E) Railroad overpass. CONTINUE AHEAD STRAIGHT (southerly).
0.05	31.85	Cross onto area of lake plain sediments.
0.35	32.2	STOP—2-way. DANGEROUS INTERSECTION AND RAILROAD CROSSING. TURN LEFT (east) and cross C & NW Railroad tracks. DO NOT STOP ON TRACKS!
0.05	32.25	TURN RIGHT (southerly) just beyond tracks on Sheridan Road in front of north entrance to Great Lakes Naval Training Center (GLNTC).
0.5	32.75	STOPLIGHT: Main Gate GLNTC. CONTINUE AHEAD (southerly).
0.2	32.95	CAUTION: underpass entrance to left for Buckley Road (SR-137). CONTINUE AHEAD STRAIGHT (south) on Sheridan Road.
1.55	34.5	CAUTION: Lake Bluff Village limits.
0.4	34.9	Prepare to turn left.
0.1	35.0	TURN LEFT (east) on Scranton Avenue.
0.05	35.05	BEAR RIGHT (southeast) on Center Avenue.
0.05	35.1	CAUTION: DANGEROUS INTERSECTION. BEAR LEFT (east) on Center Avenue.
0.1	35.2	STOP—4-way. CONTINUE AHEAD STRAIGHT (east).
0.35	35.55	STOP—4-way, Moffett Road. CONTINUE AHEAD STRAIGHT (east).
0.25	35.8	STOP 6. PARK along Center Avenue and walk straight ahead (east) across Sunrise Avenue to stone steps and path down bluff to driveway and thence to the right to sewage treatment plant.

STOP

6

Bluff erosion in Lake Bluff sewage treatment plant area. W 1/2 E 1/2 SE 1/4 NE 1/4 and E 1/2 SW 1/4 NE 1/4 NE 1/4 Sec. 21, T. 44 N., R. 12 E., 3rd P.M., Lake County; Waukegan 7.5-minute Quadrangle.

Eroding Till Bluff Just South of the Sewage Treatment Plant.

This exposure is a typical example of an oversteepened till bluff. When the exposure was first described in 1973, the absence of a protective beach allowed waves to strike with full force on the toe of the slope. Slump material from the eroding bluff was actively removed by wave action maintaining a steep bluff face. After the high water levels of 1973-1974, a longer groin was emplaced directly to the south. Since that time a narrow beach has developed that partially protects the base of the bluff. Slumping and erosion are still active on the oversteepened unvegetated parts of the bluff face.

This bluff exposes three glacial till units and intercalated sand deposits belonging to the Wadsworth Till Member of the Wedron Formation. These tills are similar in mineralogy and grain size and are associated with the Valparaiso and Lake Border Morainic Systems. The Wadsworth Till Member is the youngest glacial till exposed in Illinois, having been deposited about 13,500 radiocarbon years B.P.

The lower two tills (units 2 and 4) are separated by a bed of silt (unit 3) and make up about two-thirds of the bluff. These units are almost entirely buried in slump material from above. There is a boulder bed at the top of the second till. About 3 meters (10 feet) of cross-bedded sand overlies the till. Above the sand is a bed composed of silty clay and rock pebbles in a sand matrix.

The upper till (unit 9) is similar to the lower tills, but with slightly more silt and less sand. This till may be related to the Highland Park Moraine, the crest of which is 1.5 kilometers (0.9 mi) west of this site. At the top of the section is 1 to 2 meters (3 to 6 feet) of thinly bedded silt, sand, and clay (unit 12). Interbedded sand, silt and gravel (units 10 and 11) separate this unit from the till. Clay beds in unit 12 may contain varves. Unit 12 is believed to be nearshore lacustrine sediments deposited during one of the highest lake levels of glacial Lake Chicago. This probably correlates with the Glenwood stage that here lies at about 200 meters (650 ft) above mean sea level. Unit 12 is therefore assigned to the Equality Formation. The Modern Soil is developed in these lacustrine deposits.

A borehole located near the park entrance a block north of the exposure penetrated 6.0 meters (20 ft) of lacustrine silt and sand before reaching the till.

Factors encouraging erosion here include: (1) narrow protective beach which only partially protects the bluff from wave action, (2) materials that will quickly slump when the slope is oversteepened, (3) the removal of protective vegetative cover by earlier erosion, and (4) the presence of groundwater seeps that keep the material wet and prone to slump.

About 1,000 feet north of the sewage treatment plant and beyond the public beach is another area of severe bluff erosion that is just east of Mountain Avenue. An old groin here was destroyed by lake storms several years ago, and the remaining narrow beach was soon lost by wave erosion. Large pieces of concrete have been placed here to help protect the toe of the bluff. In addition, a newer groin was constructed just to the south of the affected area so that a beach can develop to help protect the bluff.

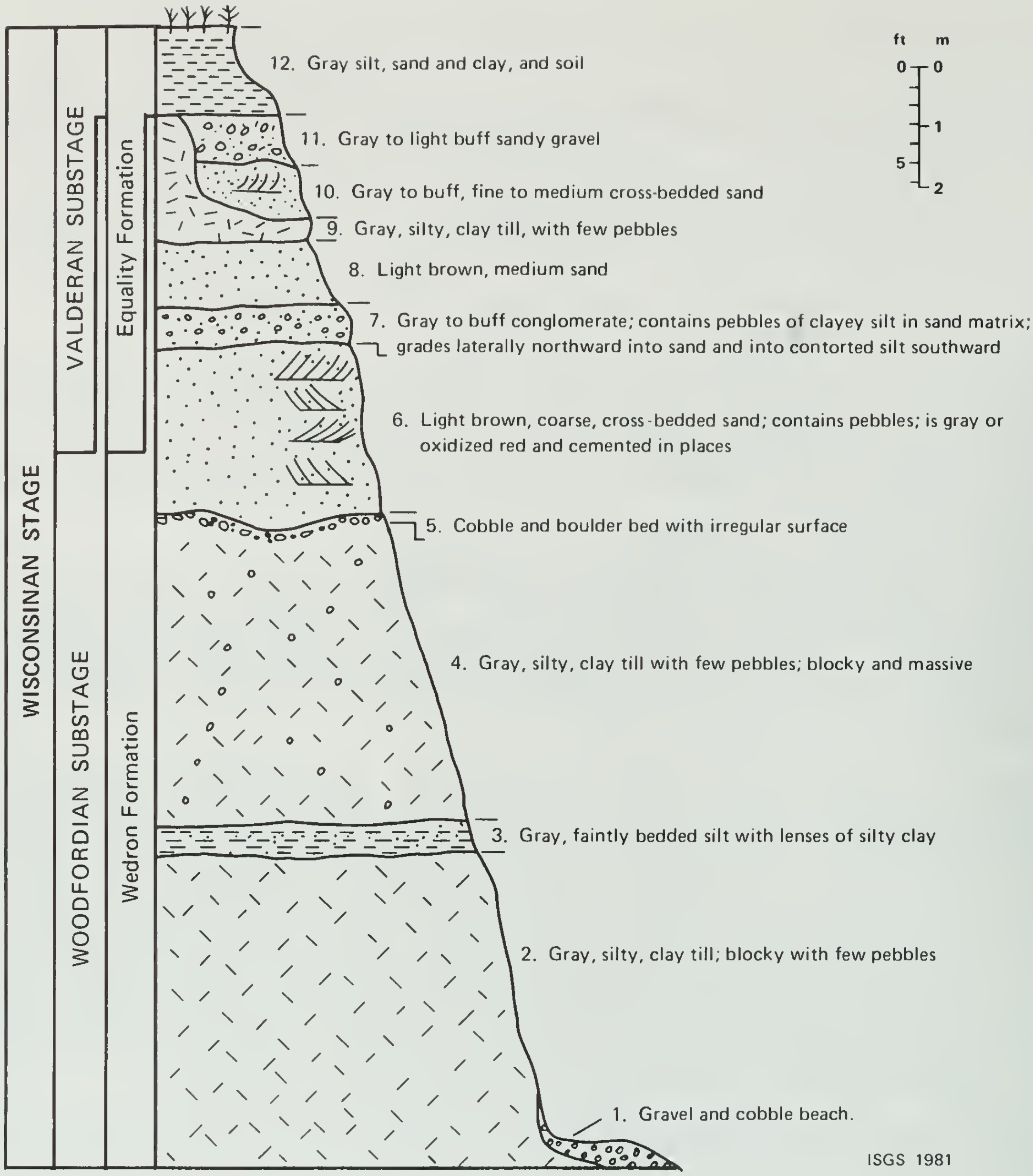
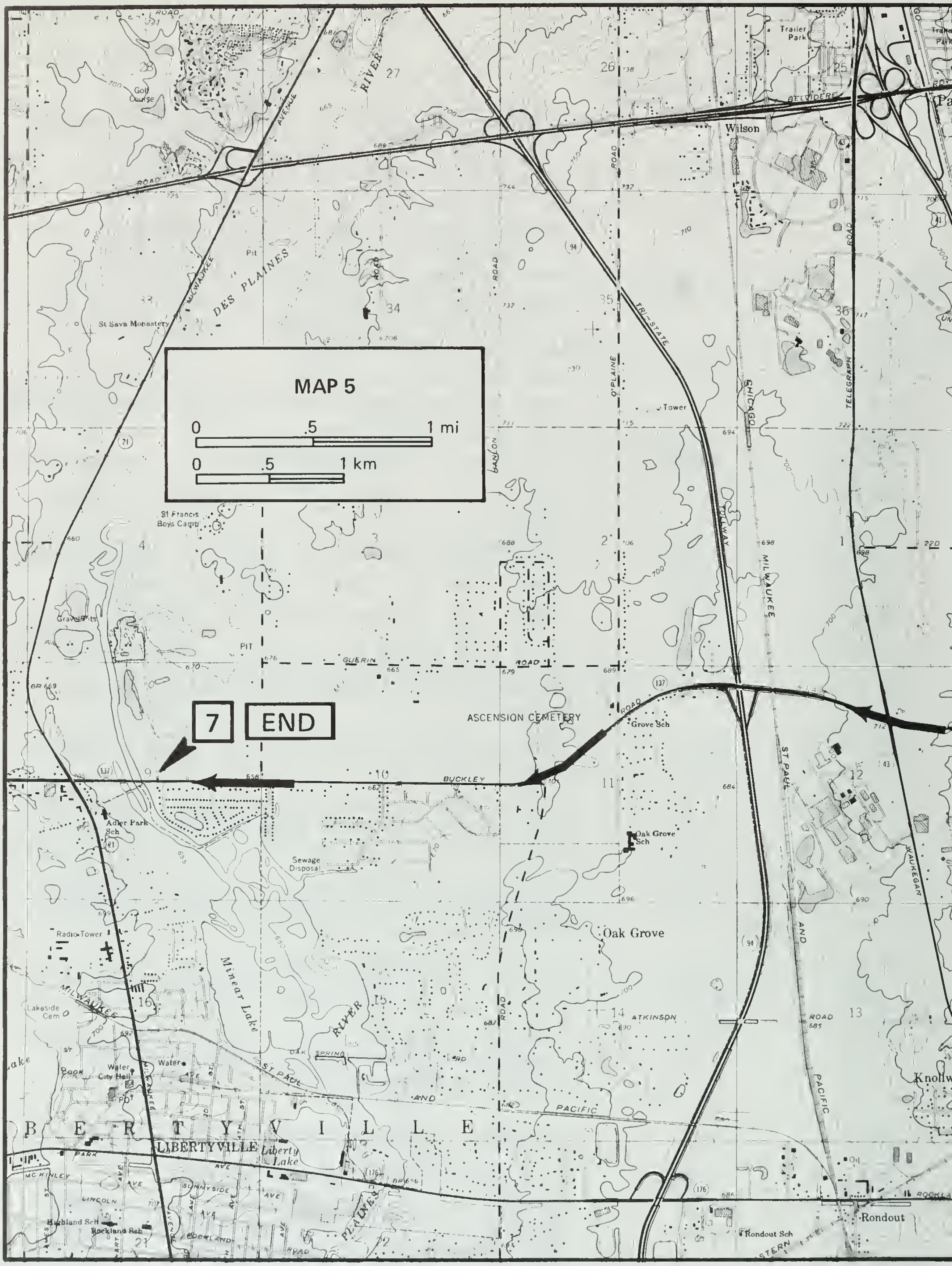


Figure 8. Stratigraphic section just south of Lake Bluff sewage disposal plant (SE¼NE¼, Sec. 21, T. 44 N., R. 12 E., Lake County, Waukegan Quadrangle).

Miles to next point	Miles from starting point	
0.0	35.8	Leave Stop 6. CONTINUE AHEAD STRAIGHT (east). See Map 4.
0.05	35.85	STOP—1-way. TURN LEFT (north) on Sunrise Avenue.
0.1	35.95	Mountain Avenue. NOTE: excellent view of Lake Michigan and the north area of bluff erosion noted at Stop 6. DO NOT get too close to the edge if you stop here. DO NOT enter the private drive at the end of Sunrise Avenue. TURN LEFT (west) on Mountain Avenue.
0.05	36.0	View to right (north) of a portion of one of the short ravines that have eroded back into the bluff. TURN LEFT (south).
0.05	36.05	STOP—1-way. TURN RIGHT (west) on Scranton Avenue.
0.15	36.2	STOP—4-way. TURN RIGHT (northwest) on Moffett Road.
0.05	36.25	North Avenue; BEAR RIGHT (north) on Moffett Road.
0.2	36.45	STOP. TURN LEFT (west) on Blodgett Avenue.
0.5	36.95	STOP—1-way. TURN RIGHT(north) on Sheridan Road.
0.25	37.2	Leave Lake Bluff.
1.2	38.4	Prepare to turn right just beyond VA Hospital entrance.
0.15	38.55	TURN RIGHT (northeast) on interchange to Buckley Road (SR-137).
0.1	38.65	STOP—1-way. Cross traffic does NOT stop. TURN LEFT (west) on Buckley Road (SR-137) and go beneath the highway and C & NW Railroad overpasses.
0.3	38.95	CAUTION: EJ & E Railroad crossing. CONTINUE AHEAD STRAIGHT (west) and ascend the backslope of the Highland Park Moraine.
0.2	39.15	STOPLIGHT. CONTINUE AHEAD STRAIGHT (west).
0.05	39.2	STOPLIGHT. CONTINUE AHEAD STRAIGHT (west).
0.35	39.55	STOPLIGHT; Green Bay Road. This is the crest of the Highland Park Moraine. CONTINUE AHEAD STRAIGHT (west) and descend the front of the Highland Park Moraine.
0.15	39.7	STOPLIGHT. CONTINUE AHEAD STRAIGHT (west).
0.1	39.8	Cross onto Blodgett ground moraine.
0.45	40.25	CAUTION: C & NW Railroad crossing. DANGEROUS CROSSING AND INTERSECTION JUST BEYOND. DO NOT stop on the tracks. Intersection is with Skokie Highway (U.S. 41). CONTINUE AHEAD STRAIGHT (west) on SR-137.


MAP 5
0 .5 1 mi
0 .5 1 km
7
END
DES PLAINES
RIVER
St Sava Monastery
Golf Course
St Francis Boys Camp
Gravel Pits
PIT
GUERIN
ROAD
BUCKLEY
ASCENSION CEMETERY
Grove Sch
Oak Grove Sch
Oak Grove
Wilson
Trailer Park
BELVIDERE
TRI-STATE
TOLLWAY
CHICAGO
MILWAUKEE
ST PAUL
AND
PACIFIC
TELEGRAPH
WAUKEGAN
O'PLAINE
ROAD
Tower
Adler Park Sch
Sewage Disposal
Radio Tower
Mineur Lake
Lakeside Cem
LIBERTYVILLE
Liberty Lake
City Hall
PARK
MC KINLEY
LINCOLN
SUNNYSIDE
ROCKLAND
Highland Sch
Rockland Sch
ATKINSON
OAK SPRING
Knollw
Rondout
Rondout Sch

Miles to next point	Miles from starting point	
0.35	40.6	Ascend backslope of Blodgett Morain. See Map 5.
0.45	41.05	STOPLIGHT: Waukegan Road (SR-43). This is the crest of the Blodgett Moraine. CONTINUE AHEAD (northwest) on Buckley Road (SR-137).
0.4	41.45	Approaching Illinois Toll Road. Cross onto Deerfield ground moraine.
0.3	41.75	Cross Illinois Toll Road (I-94). CONTINUE AHEAD (westerly).
0.35	42.1	Ascend Deerfield Moraine.
0.2	42.3	STOPLIGHT; O'Plaine Road. CONTINUE AHEAD (southwest) on SR-137.
0.4	42.7	STOPLIGHT; St. Mary's Road. Crest of Deerfield Moraine. CONTINUE AHEAD AND BEAR RIGHT (west).
0.3	43.0	Cross onto Park Ridge ground moraine.
0.8	43.8	Cross onto area underlain by valley train deposits.
0.4	44.2	Prepare to turn right.
0.15	44.35	TURN RIGHT (north) at entrance to Lake County Grading Company sand pit.

STOP 7

Sand and gravel outwash deposits exposed in the operating pit of the Lake County Grading Company. Entrance: SW 1/4 SW 1/4 SW 1/4 NE 1/4 Sec. 9, T. 44 N., R. 11 E., 3rd P.M., Lake County; Libertyville 7.5-minute Quadrangle.

The material exposed in this pit consists of outwash sand and gravel that was probably derived from the Park Ridge glacier when it was melting in this immediate vicinity. Two feet or so of silt occurs at the top of the exposure. Below the silt are about 25 feet of sand that contains a number of discontinuous streaks and lenses of fine to medium gravel. In older parts of the pit a number of dolomite boulders up to 8 feet in diameter have been found. These appear to have been found in the sand and probably were ice rafted into the area as the glacier melted. In the east part of the pit a discontinuous blue-gray clay seam up to 2 feet thick occurs near the bottom of the sand. The sand is underlain by at least 20 feet of coarse gravel and cobbles, the later up to 1 foot in diameter. The coarse materials are being mined by the two draglines.

Some 85 to 90 percent of the coarse material is dolomite, the remainder being glacial erratics brought by the glaciers from northern regions of the United States and Canada. The erratics consist of granite, gneiss, rhyolite, gabbro, basalt, quartzite, and other rock types. Although this coarse material might have been left by an earlier glacier than the Park Ridge, it seems more likely that the very coarse material was dumped close to the Park Ridge ice front as it melted. Then, as the volume of meltwater declined, finer material was carried across the area.

A number of interesting features are visible in this pit. Much of the sand deposit is cross bedded. Surface water has fluted and channeled the pit walls. Some of the channeling has been severe enough to form a number of short, steep-floored "canyons" that extend back into the adjacent upland. Alluvial fans have formed at the mouths of several of these canyons.

Farms, some quite large, dotted the countryside throughout Lake County from its earliest settlement. As the population increased and towns expanded, the demand for construction materials increased. This led to the development of sand and gravel pits along the Des Plains River. Sand and gravel have been mined from this locality for more than 20 years. The Lake County Grading Company leased this property from the Lake County Forest Preserve District in December 1980. Sand removed from this pit is used for fill sand largely, and the coarse gravel and cobbles are crushed in Grade 9, which ranges in size from 1/16 to 1 inch with the major portion being about 1/2 inch. This material is largely used for sub-base for roads and building slabs. The mining operation is compatible with the long range plans of the Lake County Forest Preserve District to develop this land into a park.

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PHYSIOGRAPHIC DIVISIONS OF ILLINOIS
Reprinted 1978
TILL PLAINS SECTION
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Rock River
Hill Country
WHEATON MORAINAL COUNTRY
Chicago Lake Plain
Green River Lowland
Bloomington
Kankakee
Plain
Galesburg
Plain
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Plain
DISSECTED TILL PLAINS SECTION
TILL PLAINS SECTION
LINCOLN HILLS SECTION
Springfield
Plain
SALEM PLATEAU SECTION
Mt. Vernon
Hill
Country
SHAWNEE HILLS SECTION
Miles
0
20
40
Ozark Plateaus Province
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ILLINOIS STATE GEOLOGICAL SURVEY

PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, the period of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. Ice sheets formed in sub-arctic regions four different times and spread outward until they covered the northern parts of Europe and North America. In North America the four glaciations, in order of occurrence from the oldest to the youngest, are called the Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

The North American ice sheets developed during periods when the mean annual temperature was perhaps 4° to 7° C (7° to 13° F) cooler than it is now and winter snows did not completely melt during the summers. Because the cooler periods lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was probably enough to lower sea level more than 300 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.

In most of Illinois, then, glacial and meltwater deposits buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have been of incalculable value to Illinois residents.

Glacial Deposits

The deposits of earth and rock materials moved by a glacier and deposited in the area once covered by the glacier are collectively called drift. Drift that is ice-laid is called till. Water-laid drift is called outwash.

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also unstratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders.

Tills may be deposited as end moraines, the arc-shaped ridges that pile up along the glacier edges where the flowing ice is melting as fast as it moves forward. Till also may be deposited as ground moraines, or till plains, which are gently undulating sheets deposited when the ice front melts back, or retreats. Deposits of till identify areas once covered by glaciers. Northeastern Illinois has many alternating ridges and plains, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified sediment deposited by water melting from the glacier is called outwash. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size--the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an esker. Cone-shaped mounds of coarse outwash, called kames, were formed where meltwater plunged through crevasses in the ice or into ponds along the edge of the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams that entered a lake quickly lost speed and almost immediately dropped the sands and gravels they carried, forming deltas at the edge of the lake. Very fine sand and silts were moved across the lake bottom by wind-generated

currents, and the clays, which stayed in suspension longest, slowly settled out and accumulated with them.

Along the ice front, meltwater ran off in innumerable shifting and short-lived streams that laid down a broad, flat blanket of outwash that formed an outwash plain. Outwash was also carried away from the glacier in valleys cut by floods of meltwater. The Mississippi, Illinois, and Ohio Rivers occupy valleys that were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. Such outwash deposits, largely sand and gravel, are known as valley trains. Valley trains may be both extensive and thick deposits. For instance, the long valley train of the Mississippi Valley is locally as much as 200 feet thick.

Loess and Soils

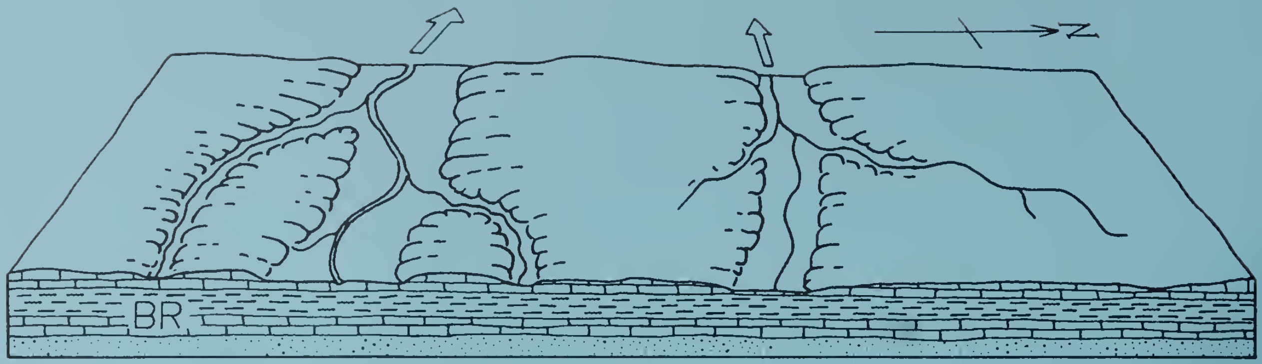
One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. Loess is the name given to such deposits of windblown silt and clay. The silt was blown from the valley trains on the floodplains. Most loess deposition occurred in the fall and winter seasons when low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and the activities of living things. Consequently, over most of the glaciated terrain, soils developed on the Pleistocene deposits and altered their composition, color, and texture. Such soils were generally destroyed by later glacial advances, but those that survive serve as keys to the identity of the beds and are evidence of the passage of a long interval of time.

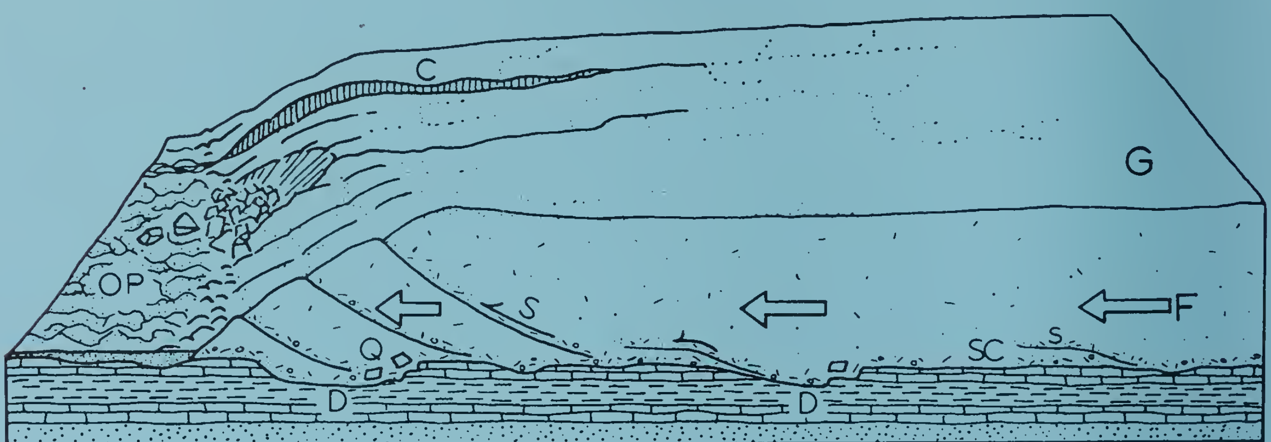
Glaciation in a Small Illinois Region

The following diagrams show how a continental ice sheet might have looked as it moved across a small region in Illinois. They illustrate how it could change the old terrain and create a landscape like the one we live on. To visualize how these glaciers looked, geologists study the landforms and materials left in the glaciated regions and also the present-day mountain glaciers and polar ice caps.

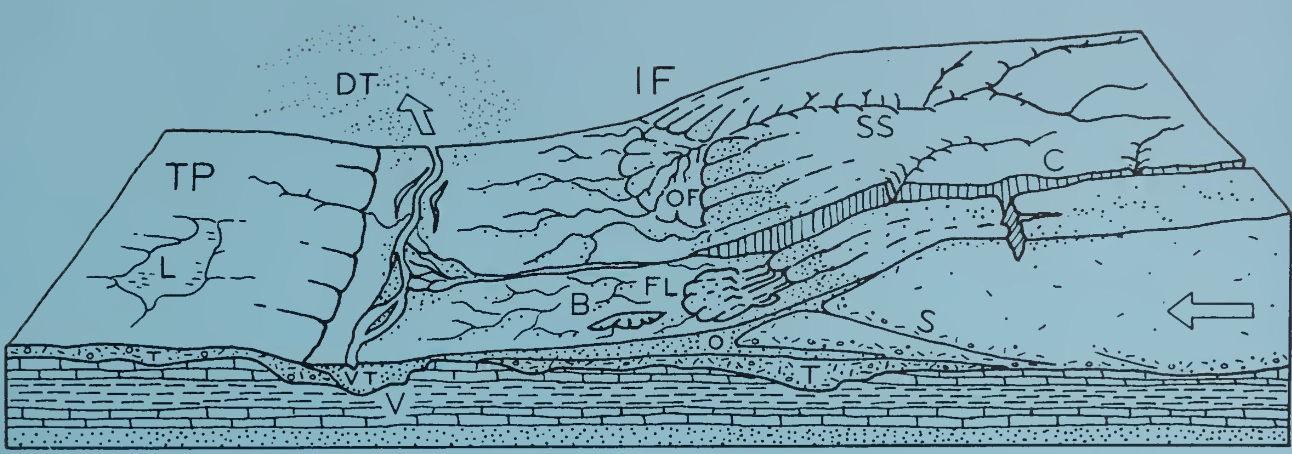
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated--layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



1. The Region Before Glaciation - Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks--layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



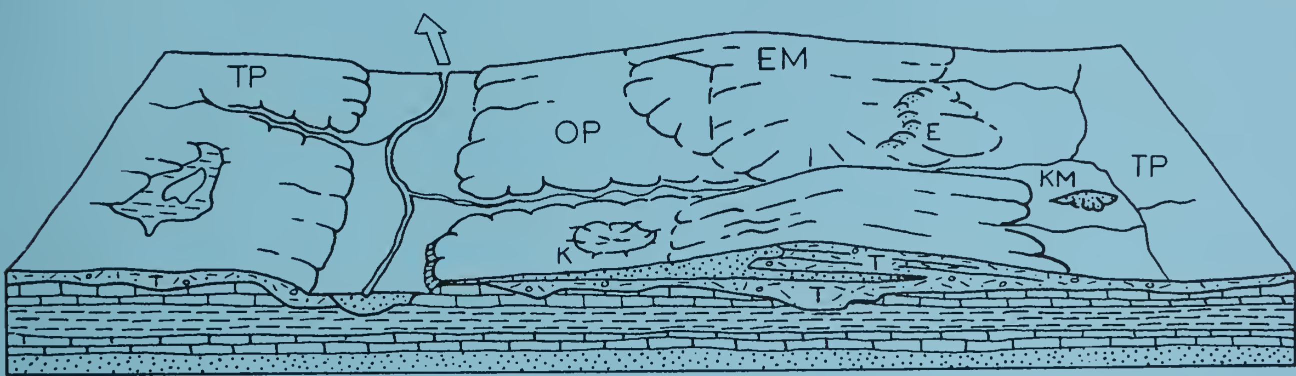
2. The Glacier Advances Southward - As the glacier (G) spreads out from its snowfield, it scours (SC) the soil and rock surface and quarries (Q)--pushes and plucks up--chunks of bedrock. These materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before the ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick , except near its margin. Its ice front advances perhaps as much as a third of a mile per year.



3. <u>The Glacier Deposits an End Moraine</u> - After the glacier advanced across the area, the climate warmed and the ice began to melt as fast as it advanced. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that was mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A superglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) was left as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remained a low spot in the terrain. As soon as its ice cover melted, meltwater drained down the valley, cutting it deeper. Later, outwash partly refilled the valley--the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles.



4. <u>The Region after Glaciation</u> - The climate has warmed even more, the whole ice sheet has melted, and the glaciation has ended. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

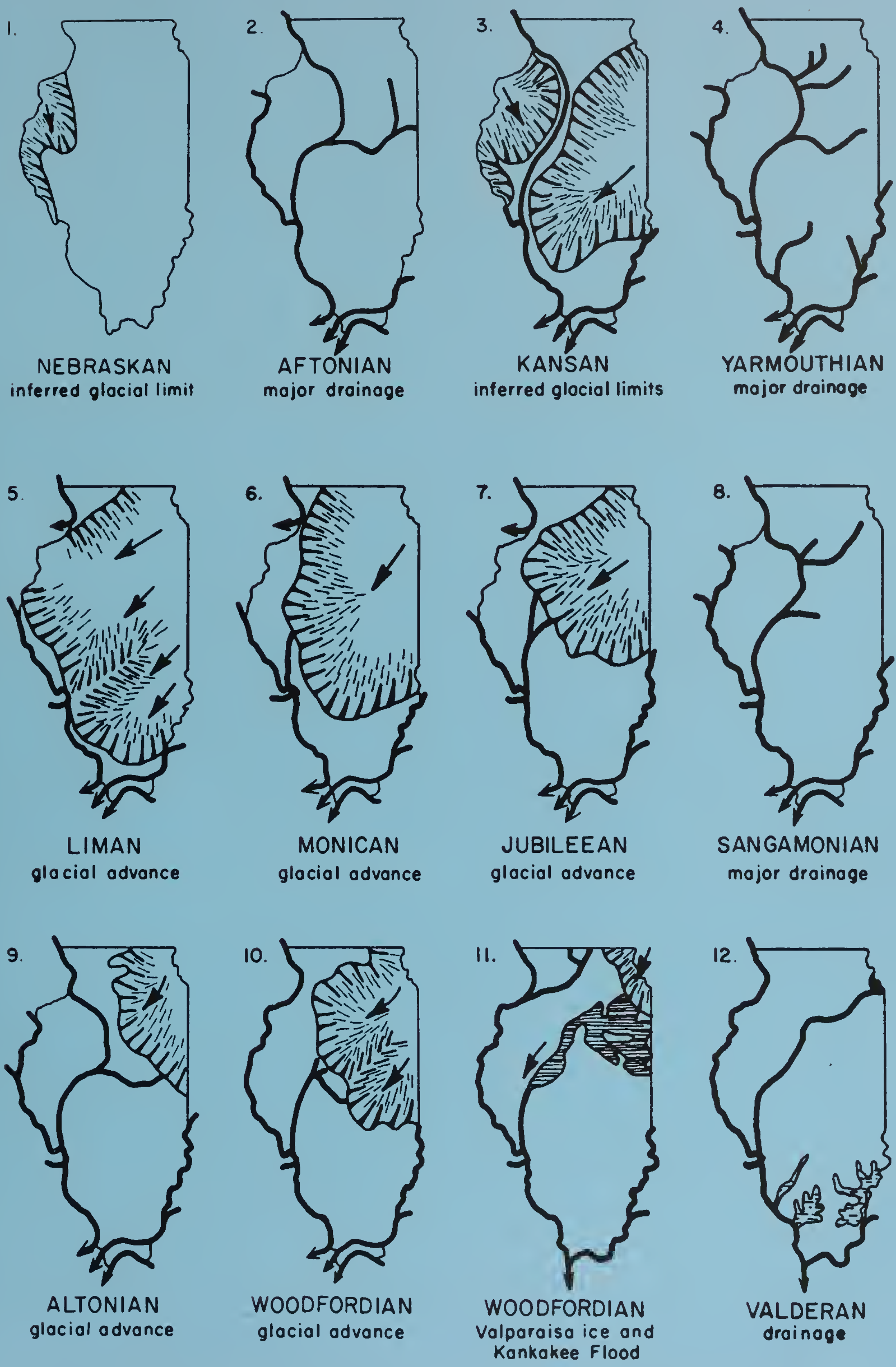
Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

TIME TABLE OF PLEISTOCENE GLACIATION

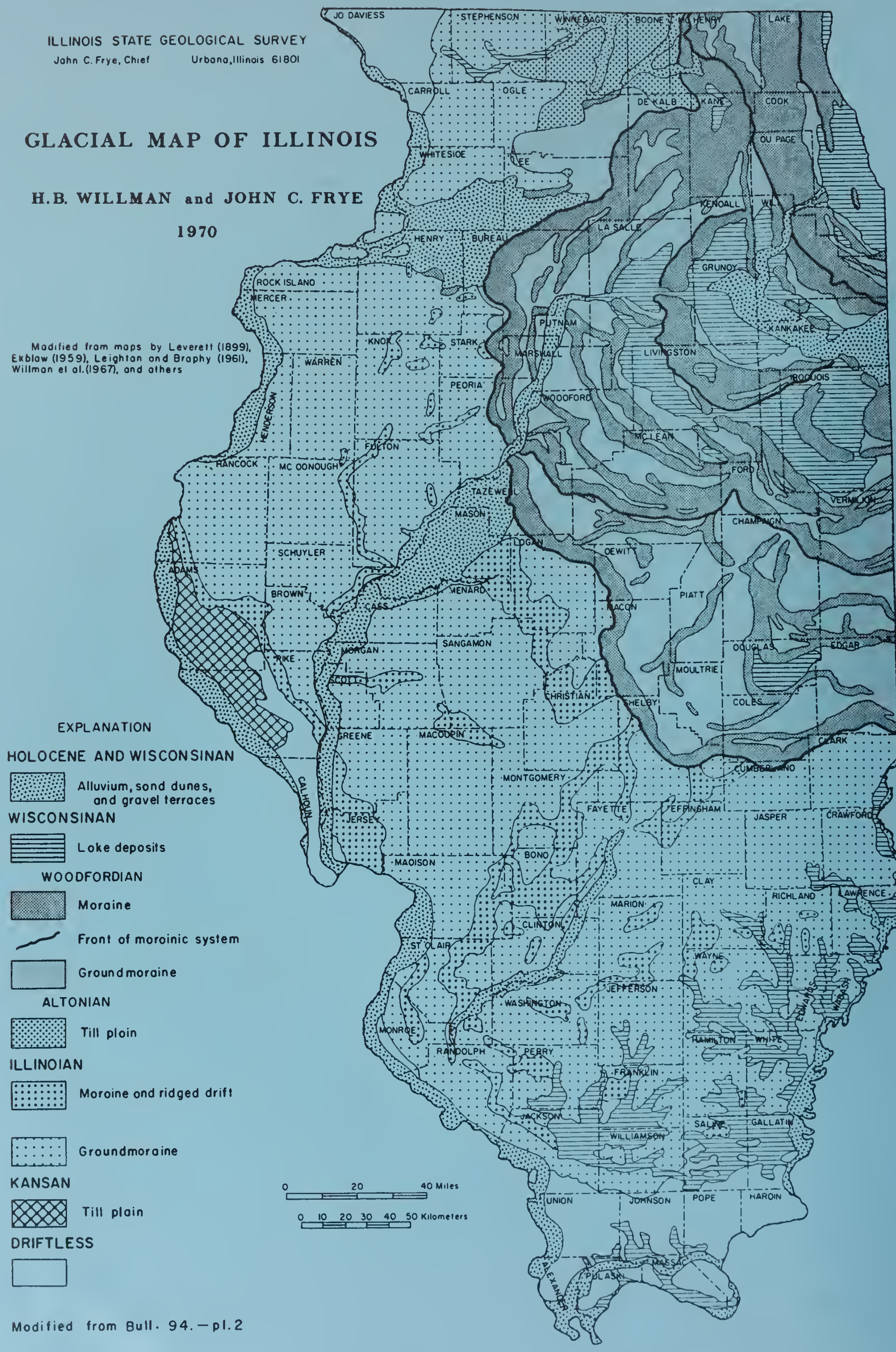
STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
HOLOCENE	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	7,000		
WISCONSINAN (4th glacial)	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	22,000		
	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers
	75,000		
SANGAMONIAN (3rd interglacial)		Soil, mature profile of weathering	
	175,000		
ILLINOIAN (3rd glacial)	Jubileean	Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Monican	Drift, loess	
	Liman	Drift, loess	
	300,000		
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering	
	600,000		
KANSAN (2nd glacial)		Drift, loess	Glaciers from northeast and northwest covered much of state
	700,000		
AFTONIAN (1st interglacial)		Soil, mature profile of weathering	
	900,000		
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois
	1,200,000 or more		

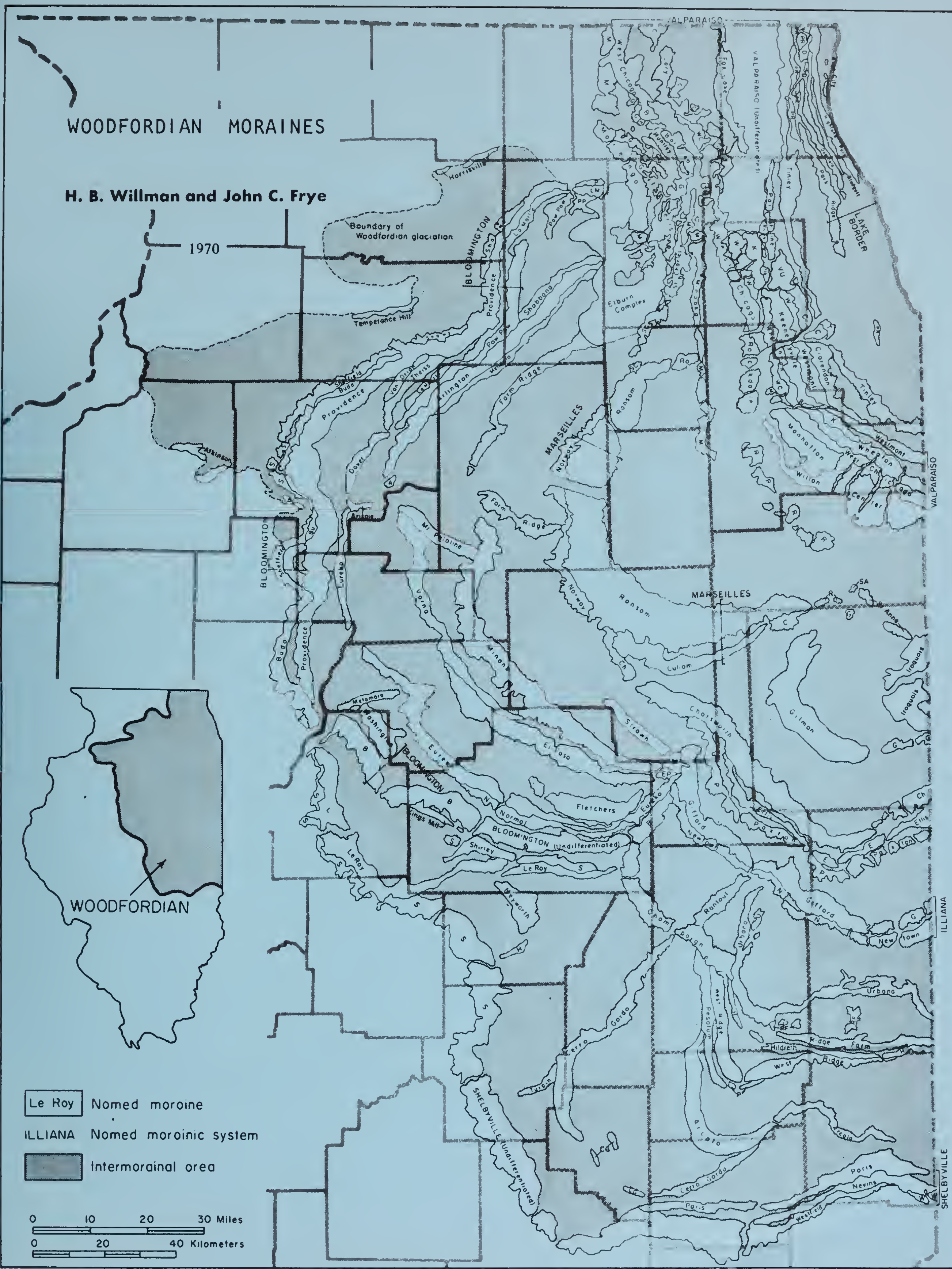
(Illinois State Geological Survey, 1973)

SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS

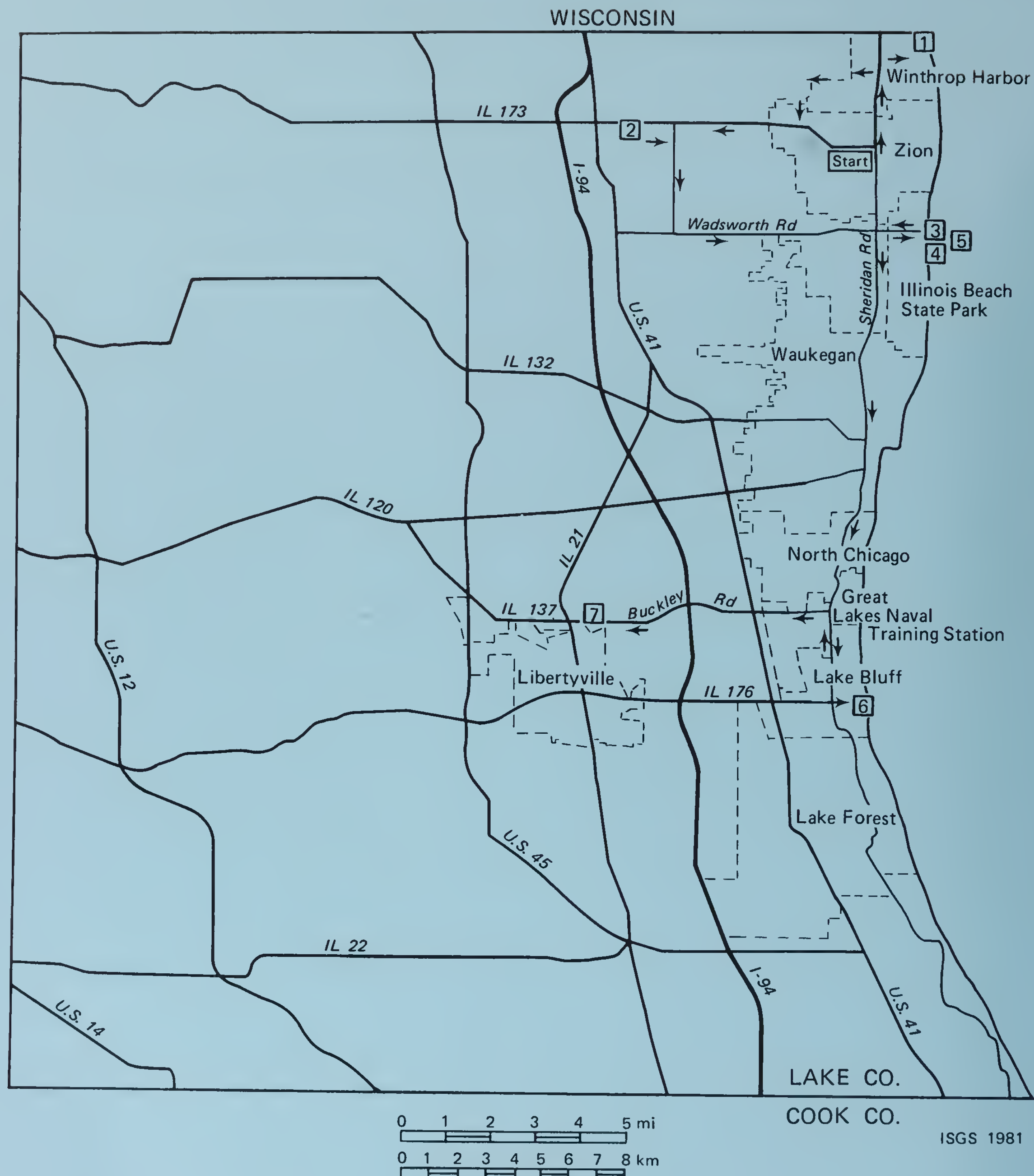


(From Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)


ILLINOIS STATE GEOLOGICAL SURVEY
John C. Frye, Chief Urbana, Illinois 61801
GLACIAL MAP OF ILLINOIS
H.B. WILLMAN and JOHN C. FRYE
1970
Modified from maps by Leverett (1899), Ekblaw (1959), Leighton and Brophy (1961), Willman et al. (1967), and others
EXPLANATION
HOLOCENE AND WISCONSINAN
Alluvium, sand dunes, and gravel terraces
WISCONSINAN
Lake deposits
WOODFORDIAN
Moraine
Front of morainic system
Groundmoraine
ALTONIAN
Till plain
ILLINOIAN
Moraine and ridged drift
Groundmoraine
KANSAN
Till plain
DRIFTLESS
0 20 40 Miles
0 10 20 30 40 50 Kilometers
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MC HENRY
LAKE
CARROLL
OGLE
DE KALB
KANE
COOK
DU PAGE
WHITESIDE
LEE
KENDALL
WILL
HENRY
BUREAU
LA SALLE
GRUNDY
ROCK ISLAND
MERCER
PUTNAM
KANKAKEE
KNOX
STARK
MARSHALL
LIVINGSTON
WARREN
PEORIA
IROQUOIS
HENDERSON
WOODFORD
MC LEAN
FULTON
HANCOCK
MC DONOUGH
FORD
TAZEWELL
VERMILION
MASON
CHAMPAIGN
LOGAN
SCHUYLER
DEWITT
ADAMS
MENARD
PIATT
BROWN
CASS
MACON
MORGAN
SANGAMON
DOUGLAS
EDGAR
PIKE
SCOTT
MOULTRIE
CHRISTIAN
SHELBY
COLES
GREENE
MACOUPIN
CLARK
CUMBERLAND
MONTGOMERY
CALHOUN
FAYETTE
EFFINGHAM
JASPER
CRAWFORD
JERSEY
MADISON
BOND
CLAY
RICHLAND
LAWRENCE
MARION
CLINTON
ST CLAIR
WAYNE
JEFFERSON
EDWARDS
WABASH
WASHINGTON
MONROE
HAMILTON
WHITE
RANDOLPH
PERRY
FRANKLIN
JACKSON
SALINE
GALLATIN
WILLIAMSON
UNION
JOHNSON
POPE
HARDIN
MASSAC
PULASKI
ALEXANDER
Modified from Bull. 94.—pl. 2



WOODFORDIAN MORAINES
H. B. Willman and John C. Frye
1970
Boundary of Woodfordian glaciation
WOODFORDIAN
Le Roy Named moraine
ILLIANA Named morainic system
Intermorainal area
0 10 20 30 Miles
0 20 40 Kilometers
ALPARAISO
VALPARAISO (Undifferentiated)
LAKE BORDER
BLOOMINGTON
MARSEILLES
VALPARAISO
ILLIANA
SHELBYVILLE
SHELBYVILLE (Undifferentiated)
BLOOMINGTON (Undifferentiated)
Elburn Complex
Temperance Hill
Providence
Shabbona
Farm Ridge
Arlington
Ransom
Manhattan
Wheaton
Wilton
Minonk
Cullom
Chatsworth
Gilman
Iroquois
Normal
Fletchers
Shirley
Le Roy
Eureka
El Paso
Metamora
Washington
Strawn
Rantoul
Champaign
Urbana
West Ridge
Hildreth
Cerro Gordo
Paris
Nevins
Westfield
Newtown
Gifford
Atkinson
Sheffield
Buda
Dover
Tinley
Park Ridge
Clarendon
Keeneyville
Wheeling
Ellis
Arcola
Pesotum
Heyworth



WISCONSIN
1
Winthrop Harbor
IL 173
2
Zion
Start
I-94
Wadsworth Rd
3
5
4
Sheridan Rd
Illinois Beach
State Park
U.S. 41
IL 132
Waukegan
IL 120
IL 21
North Chicago
Great
Lakes Naval
Training Station
IL 137
7
Buckley Rd
U.S. 12
Libertyville
Lake Bluff
IL 176
6
Lake Forest
U.S. 45
IL 22
I-94
U.S. 41
U.S. 14
LAKE CO.
COOK CO.
0 1 2 3 4 5 mi
0 1 2 3 4 5 6 7 8 km
ISGS 1981